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ASSESSMENT OF USER NEEDS OF PRIMARY BIODIVERSITY DATA: ANALYSIS, CONCERNS, AND CHALLENGES

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Abstract — A Content Needs Assessment (CNA) survey has been conducted in order to determine what GBIF-mediated data users may be using, what they would be using if available, and what they need in terms of primary biodiversity data records. The survey was launched in 2009 in six languages, and collected more than 700 individual responses. Analysis of the responses showed some lack of awareness about the availability of accessible primary data, and pointed out some types of data in high demand for linking to distribution and taxonomic data now derived from the GBIF cache. A notable example was linkages to molecular data. Also, the CNA survey uncovered some biases in the design of user needs surveys, by showing demographic and linguistic effects that may have influenced the distribution of responses received in analogous surveys conducted at the global scale.

INTRODUCTION

Biodiversity research is becoming a data-intensive science (Kelling et al., 2009). The more than 267 million primary biodiversity records that hundreds of data publishers were making openly available through GBIF by the end of 2010 International Biodiversity Year (GBIF 2010) is a significant asset, and a valuable form of scientific capital (Borgman, 2003, 2007).

Scientific data are expensive to produce but can be of tremendous future value (Borgman, 2007), although quantifying such future value is difficult without some indication about future data uses. Nevertheless, the value for natural history collections (NHCs) has been demonstrated, in accord with long-standing predictions (Grinnell, 1910). Such values are seen as extending to various kinds of data derived from biodiversity research which need to be held in perpetuity as well. Of course, not all available data are fit for all uses (Hill et al., 2010). The expense of producing data, and maintaining the cyberinfrastructure needed for their open access, delivery, and data-intensive collaborative research (Borgman et al., 2006), justifies increased efforts to assess what types of biodiversity data are most needed by researchers. This may help optimize resource allocation and research output. In 2009, GBIF set up a Content Needs Assessment Task Group (CNA TG) to address this assessment (GBIF 2009a).

The objective of CNA is to get a first-hand idea about the user needs of biodiversity data (Chavan et al., 2010). Two main tools are available for CNA: information mining (including literature review), and surveys. While the former may be thought of as retrospective research, collating documented uses in response to specific needs, the latter can proceed both ways: describing researchers' past, present and possible future requirements.

In 2009, CNA TG conducted a survey with the purpose of collecting information on the demography of use of biodiversity data, and understanding the myriad of broad 'primary biodiversity data' needs across user communities (GBIF, 2009). The survey also sought input to determine the unique scientific and policy contributions of uses made of data mobilized and accessible through the GBIF community.

DESIGN

The survey contained 21 questions spread over 6 sections (Table 1): (a) respondent profile, (b) uses of primary biodiversity data, (c) access to primary biodiversity data, (d) data quality and quantity requirements, (e) species level data requirements, and (f) usefulness of GBIF mobilised data. The survey included an introduction succinctly describing GBIF and the objective of CNA (Table 1). Most questions were multiple-choice, although estimates were required for some quantity data. Also, most questions included an option for a free-text answer not covered by available choices.

Table 1: List of questions and options

Overhead: GBIF Content Needs Assessment (CNA) Survey: Introduction

[Objective of CNA Survey, Description of GBIF, estimated time to completion (21 questions, 18 minutes), Anonymity assurance].

Section (a): GBIF Content Needs Assessment (CNA) Survey: User Profile

User profile question Q1. Details of the Person undertaking this survey.

Options/Suboptions: Name; Organisation/institution affiliated with; Street/PO box; City; State; Country; ZIP CODE; Phone/Mobile; Email; Web/URL. *(Free-text answers)*

User profile question Q2. Describe your organization (please tick one or several options)

Options/Suboptions: Academic / educational institution; Research institution; National agency; Non Governmental Organisation (NGO); Intergovernmental Organisation (IGO) or Multilateral Convention; Private company; Individual researcher or Naturalists (e.g. citizen scientists); Others (please specify). *(Exclusive multiple choice)*

User profile question Q3. Main interest/business of your organization (please tick one or several options)

Options/Suboptions: Conservation Science (including taxonomic research); Bioproductivity / Bioprospecting (agriculture; fisheries; forestry; etc.); Biodiversity; Biomedical and/or Public health; Biotechnology; Biosecurity; Natural Resources Management; Industrial / Commercial use of natural resources; Exhibition / Educational / Academic; Others (please specify). *(Non-exclusive multiple choice)*

Section (b): GBIF CNA Survey: Uses of Primary Biodiversity Data.

This section of the survey is designed to understand the purpose for which 'primary biodiversity data' is used by various stakeholders. DEFINITION: Primary biodiversity data is defined as the digital text or multimedia data record detailing the instance of an organism – or the what, where, when, how and by whom of the organisms occurrence and recording. The uses of primary biodiversity data are wide and varied, and encompass virtually every aspect of human endeavor – food, shelter, health, recreation, art and history, society, science & politics, etc. Furthermore, such data is essential for predicting the sustainable future of our planet, and therefore of all living beings.

Question (Q) 01. List the ways in which you use Primary Biodiversity Data (please choose one or several options)

Options/Suboptions: Taxonomy; Biogeographic studies; Species diversity & populations; Life histories & phonologies; Endangered, migratory and invasive species; Impact of climate change; Ecology, evolution & genetics; Environmental regionalization; Conservation planning; Sustainable Use; Natural Resources Management; Agriculture, fisheries, forestry and mining; Nursery & pet industry; Health & public safety; Bioprospecting; Forensics; Border control and wildlife trade; Education & public outreach; Ecotourism; Art & History; Society and politics; Recreation; Human infrastructure planning; Industrial use; Environmental impact management; Others (please specify). *(Non-exclusive multiple choice)*

Q02. Provide example documentation (reports/papers/presentations) where Primary Biodiversity Data has been used by you/your group?

NOTE: Please provide literature references, URLs of web sites, news items. Please also email us a copy of the report/paper etc. at contentneeds@gbif.org.

Options/Suboptions: Separate fields for multiple examples. *(Free-text answers)*

Section (c): GBIF CNA Survey: Access to Primary Biodiversity Data.

In this section, GBIF seeks to learn how users access primary biodiversity data (please choose one or several options). The objective is to understand the mechanisms employed and the frequency for accessing primary biodiversity data.

Q03. How do you access primary biodiversity data?

Options/Suboptions: Through your own field works/surveys; Through hardcopy, literature survey (non-digital form); Through primary publications (e.g. taxonomic monographs, maps of species observations); Through access to offline digital data sets (CDROM/DVD/tapes etc.); Through the GBIF Data Portal (http://data.gbif.org); Through other web based data portals (please specify); Through FTP sites (please specify); Through institutional agreements; Through payment basis; Through free and open datasests within and outside of your institution; Through reciprocal agreements with other groups/individuals; Through others (please specify). *(Non-exclusive multiple choice)*

Q04. Frequency of access

Options/Suboptions: Daily basis; Once a month; Once a quarter; Bi-annual; Can not determine (on Need basis); Others (please specify). *(Exclusive multiple choice)*

Q05. Some of the datasets mobilised through GBIF have multiple access points (e.g. OBIS mobilised data set can typically have three access points – GBIF data portal, OBIS portal, and data sets own portal). How do you access such data sets?

Options/Suboptions: Only through GBIF Portal; Only through thematic/regional aggregator portal(s); Directly through datasets own portal(s); All of the above. *(Exclusive multiple choice)*

Q06. If you are accessing datasets through access points other than the GBIF data portal, why?

Options/Suboptions: Lack of awareness about accessibility through the GBIF portal; Have been using these access points for a long time; Ease of use; More specific search features; Workflow integration; Others (please specify). *(Non-exclusive multiple choice)*

Q07. Select the data formats which you often choose to access the primary biodiversity data.

Options/Suboptions: MySql (dump); Excel; Tab delimited; Comma separated values; XML; Maps as images; Kml; Others (please specify). *(Non-exclusive multiple choice)*

Q08. GBIF serve data in all the formats listed in the previous question. If GBIF were to serve data in other formats, which would be your preference(s)? *(Free-text answers)*

Q09. List the other types of data you use together with primary biodiversity data? (e.g. satellite imagery, environmental data layers such as salinity, temperature etc., land use data, infrastructure development such as housing, roads, dams, etc.) *(Free-text answers)*

Section (d): GBIF CNA Survey: Quality and Quantity Requirements

Q10. Types or Nature of Primary Biodiversity Data Required?

Options/Suboptions: Taxonomic names/checklists; Occurrence records (presence only); Occurrence records (including absence records); Population density/dynamics; Species interaction data; Species information (descriptive data); Others (please specify). *(Non-exclusive multiple choice)*

Q11. Quantity of data required for each data type?

Options/Suboptions: Taxonomic names/checklists; Occurrence records; Population density/dynamics; Multimedia resources; Others (please specify). (*Choice matrix. Exclusive column options for each option row: 1-100 records; 101-1000 records; 1001-10000 records; 10000+ records)*

Q12. For which type of environments do you use/need more primary biodiversity data?

Options/Suboptions: Marine: Coasts; Marine: Oceans; Marine: Deep Seas; Marine: Islands; Marine: Estuarine; Inland: Wetlands; Inland: River basin; Terrestrial: Tropical forests; Terrestrial: Temperate forests; Terrestrial: Deserts; Terrestrial: Grasslands; Terrestrial: Agro-ecosystem; Terrestrial: Mountains; Others (please specify). *(Choice matrix. Exclusive column options for each option row: Frequent Use; Less Frequent Use; Occasionally required; Not required)*

Q13. Which data at the ecosystem level are the most required by you and at what scale?

Options/Suboptions: Ecoregions; Vegetation coverage; Protected areas; Temperature; Precipitation; Soil; Watersheds; Basins; Others (please specify). (*Choice matrix. Non-exclusive column options for each option row: Global; Regional; National; Provincial; Local)*

Section (e): GBIF CNA Survey: Species-level data requirements.

The objective of this section is to understand data on which taxa's is most often required.

Q14. Which data at the plant species level are most required by you and at what scale? Please specify child taxa or common names in the box below.

Options/Suboptions: Plants: Monocots; Plants: Dicots; Plants: Bryophytes; Plants: Pteridophytes; Plants: Gymnosperms; Plants: Algae; Plants: Others (please specify). (*Choice matrix. Non-exclusive column options for each option row: Global; Regional; National; Provincial; Local)*

Q15. Which data at the animal species level are the most required by you and at what scale? Please specify child taxa or common names in the box below.

Options/Suboptions: Phylum: Acanthocephala; Phylum: Annelida; Phylum: Arthropoda; Phylum: Brachiopoda; Phylum: Cephalorhyncha; Phylum: Chaetognatha; Phylum: Chordata; Phylum: Cnidaria; Phylum: Ctenophora; Phylum: Echinodermata; Phylum: Echiura; Phylum: Ectoprocta; Phylum: Entoprocta; Phylum: Gastrotricha; Phylum: Gnathostomulida; Phylum: Hemichordata; Phylum: Mesozoa; Phylum: Mollusca; Phylum: Myxozoa; Phylum: Nematoda; Phylum: Nemertea; Phylum: Onychopora; Phylum: Phoronida; Phylum: Placozoa; Phylum: Platyhelminthes; Phylum: Porifera; Phylum: Rotifera; Phylum: Sipuncula; Phylum: Tardigrada; Others (please specify). (*Choice matrix. Non-*

exclusive column options for each option row: Global; Regional; National; Provincial; Local)

Q16. Which data at the fungi, virus and microbial species level are most required by you and at what scale? Please specify child taxa or common names in the box below.

Options/Suboptions: Microbes; Fungi; Virus; Others (please specify). (*Choice matrix. Non-exclusive column options for each option row: Global; Regional; National; Provincial; Local)*

Q17. What are the most important characteristics that you generally want for species occurrence data?

Options/Suboptions: Precise/accurate geo-referenced data; Metadata on uncertainty about geographical/georeferenced data; Pre-1990 data; Post-1990 data; Type specimens in scientific collections; Source of information; Images; Synonyms of species name; Common name of species; Species habitat descriptions; Others (please specify). *(Non-exclusive multiple choice)*

Section (f): GBIF CNA Survey: Usefulness of GBIF mobilised data

Q18. Does GBIF mobilised data satisfy your needs?

Options/Suboptions: No, I have not at all used GBIF mobilised data; No, not at all useful for my applications; Maybe, partially useful for my applications; Yes, completely useful for my applications; Please specify for what applications you use GBIF data: *(Exclusive multiple choice)*

Q19. If GBIF mobilised data is partially or absolutely not useful for your applications, we would like to know which needs are not satisfied by the GBIF mobilised data?

Options/Suboptions: Type of data; Data volume/quantity; Spatial extent; Taxonomic coverage; Georeference quality; Age of data; Sequence based associated occurrence data; Others (please specify): *(Non-exclusive multiple choice)*

Q20. What type of data would you like to see becoming increasingly discoverable and accessible through GBIF?

Options/Suboptions: Taxonomic Names/Checklist data; Specimen based occurrence data; Observation based occurrence data; Multimedia resources based occurrence data; Other types of observations/occurrences data (e.g. agro-forestry, fish landing, migration etc.); Names and occurrences extracted from publications; Sequence based associated occurrence data; Any other (please specify): *(Non-exclusive multiple choice)*

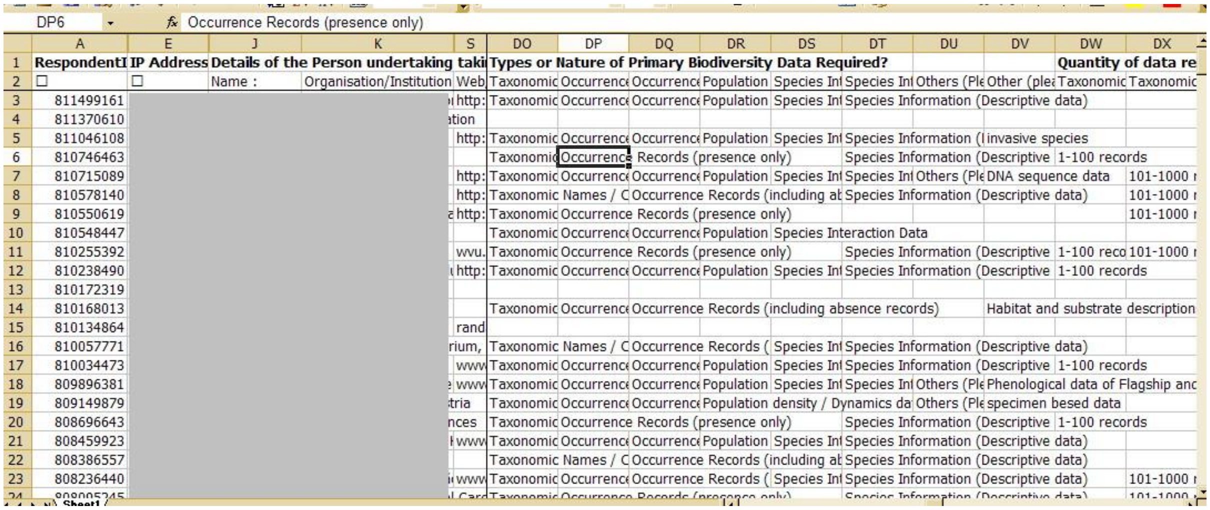
Q21. If you have any comments not covered by the survey, feel free to enter them here. *[Free-text answers]*

SurveyMonkey (http://www.surveymonkey.com) was used to design and host the survey. On May7th, 2009, the survey was launched in English, French and Spanish. Chinese (traditional and simplified) and Russian versions of the survey were launched a week later on May 14th, 2009 (GBIF 2009b, GBIF 2009c, GBIF 2009d). While English, French and Spanish survey versions were closed on June 12th, 2009, Chinese and Russian versions were drawn to a close on June 19th, 2009.

Survey announcements were widely circulated using, (a) GBIF communications portal, (b) GBIF mailing lists, (c) TAXACOM, (d) International Commission on Zoological Nomenclature, (e) Taxonomic Database Working Group, and (f) Expert Centre for Taxonomic Identification mailing list. The GBIF Secretariat made a request to the Convention on Biological Diversity (CBD) Secretariat to disseminate the launch of the survey, and this request was implemented by the CBD Secretariat. Task Group members also forwarded requests to other national, professional or subject-specific lists and networks.

ANALYTICAL METHODS

SurveyMonkey output was supplied as a set of Excel tables for each version, recording individual respondents in rows and each single possible option for each question as a column. Cells were filled with the selected, verbatim options (see Fig. 1). As the number of options exceeded Excel's maximum column capacity, additional Excel books were produced by the site holding additional columns. In all, twelve sheets (two for each distinct survey) were downloaded.

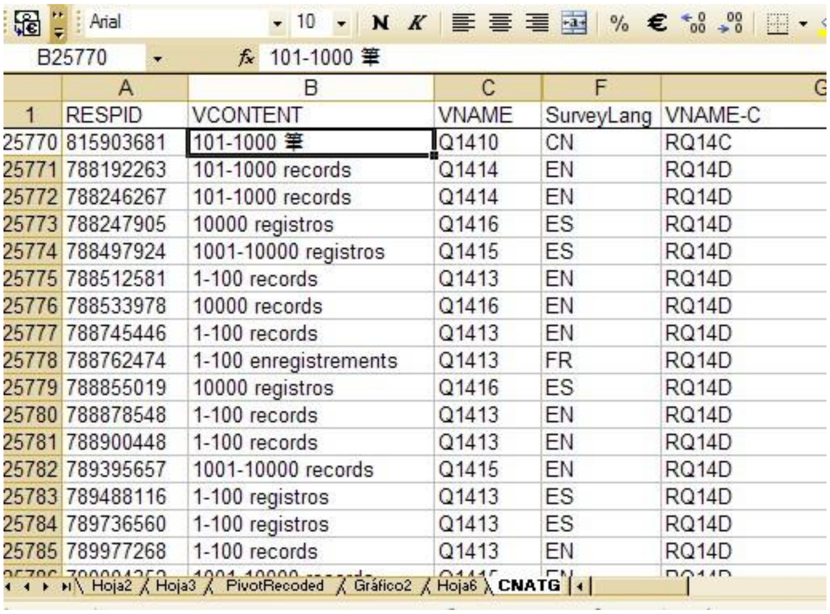


DP6 | Occurrence Records (presence only)

	A	E	J	K	S	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX
1	RespondentI	IP Address	Details of the Person undertaking taki			Types or Nature of Primary Biodiversity Data Required?								Quantity of data re	
2	□	□	Name :	Organisation/Institution	Web	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Int	Others (Ple	Other (plea	Taxonomic	Taxonomic
3	811499161	[redacted]	[redacted]	[redacted]	http:	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Information (Descriptive data)				
4	811370610	[redacted]	[redacted]	[redacted]	ation										
5	811046108	[redacted]	[redacted]	[redacted]	http:	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Information (		invasive species		
6	810746463	[redacted]	[redacted]	[redacted]		Taxonomic	Occurrence Records (presence only)				Species Information (Descriptive			1-100 records	
7	810715089	[redacted]	[redacted]	[redacted]	http:	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Int	Others (Ple	DNA sequence data		101-1000 r
8	810578140	[redacted]	[redacted]	[redacted]	http:	Taxonomic Names / C		Occurrence Records (including ab			Species Information (Descriptive data)				101-1000 r
9	810550619	[redacted]	[redacted]	[redacted]	http:	Taxonomic	Occurrence Records (presence only)								101-1000 r
10	810548447	[redacted]	[redacted]	[redacted]		Taxonomic	Occurrence	Occurrence	Population	Species Interaction Data					
11	810255392	[redacted]	[redacted]	[redacted]	wvu.	Taxonomic	Occurrence Records (presence only)				Species Information (Descriptive			1-100 reco	101-1000 r
12	810238490	[redacted]	[redacted]	[redacted]	http:	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Information (Descriptive			1-100 records	
13	810172319	[redacted]	[redacted]	[redacted]											
14	810168013	[redacted]	[redacted]	[redacted]		Taxonomic	Occurrence	Occurrence Records (including absence records)					Habitat and substrate description		
15	810134864	[redacted]	[redacted]	[redacted]	rand										
16	810057771	[redacted]	[redacted]	[redacted]	rium,	Taxonomic Names / C		Occurrence Records (		Species Int	Species Information (Descriptive data)				
17	810034473	[redacted]	[redacted]	[redacted]	www	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Information (Descriptive			1-100 records	
18	809896381	[redacted]	[redacted]	[redacted]	www	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Int	Others (Ple	Phenological data of Flagship anc		
19	809149879	[redacted]	[redacted]	[redacted]	tria	Taxonomic	Occurrence	Occurrence	Population density / Dynamics da			Others (Ple	specimen besed data		
20	808696643	[redacted]	[redacted]	[redacted]	nces	Taxonomic	Occurrence Records (presence only)				Species Information (Descriptive			1-100 records	
21	808459923	[redacted]	[redacted]	[redacted]	www	Taxonomic	Occurrence	Occurrence	Population	Species Int	Species Information (Descriptive data)				
22	808386557	[redacted]	[redacted]	[redacted]		Taxonomic Names / C		Occurrence Records (including ab			Species Information (Descriptive data)				
23	808236440	[redacted]	[redacted]	[redacted]	www	Taxonomic	Occurrence	Occurrence Records (		Species Int	Species Information (Descriptive data)				101-1000 r
24	808005245	[redacted]	[redacted]	[redacted]	Card	Taxonomic	Occurrence Records (presence only)				Species Information (Descriptive data)				101-1000 r

Figure 1: A small section of one of the raw files as produced by the survey software, arranged in an Excel spreadsheet. Each row corresponds to one respondent (personal data obscured).

As this layout was not amenable to direct analysis (Chavan et al., 2010), a 48,767-record database was constructed where each record was an individual option or response supplied by each respondent to each question (see Fig. 2). In order to nullify language differences between surveys, free-text answers coming from fixed options were then recoded homogeneously across all six surveys, and merged together into a single file. The original language was however retained as a field, allowing for grouping when the language factor was needed later in the analysis. Also, verbatim responses (in their original language, before recoding) were retained for reference as fields.



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	A	B	C	F	G
1	RESPID	VCONTENT	VNAME	SurveyLang	VNAME-C
25770	815903681	101-1000 筆	Q1410	CN	RQ14C
25771	788192263	101-1000 records	Q1414	EN	RQ14D
25772	788246267	101-1000 records	Q1414	EN	RQ14D
25773	788247905	10000 registros	Q1416	ES	RQ14D
25774	788497924	1001-10000 registros	Q1415	ES	RQ14D
25775	788512581	1-100 records	Q1413	EN	RQ14D
25776	788533978	10000 records	Q1416	EN	RQ14D
25777	788745446	1-100 records	Q1413	EN	RQ14D
25778	788762474	1-100 enregistrements	Q1413	FR	RQ14D
25779	788855019	10000 registros	Q1416	ES	RQ14D
25780	788878548	1-100 records	Q1413	EN	RQ14D
25781	788900448	1-100 records	Q1413	EN	RQ14D
25782	789395657	1001-10000 records	Q1415	EN	RQ14D
25783	789488116	1-100 registros	Q1413	ES	RQ14D
25784	789736560	1-100 registros	Q1413	ES	RQ14D
25785	789977268	1-100 records	Q1413	EN	RQ14D

Figure 2: Data arranged as a database. Each row is an individually selected option in the survey, with fields for language (SurveyLang), question and option number (VNAME), verbatim answer (VCONTENT), and recoded (language-free) answer (VNAME-C).

This recoding also allowed for the original number of variables in the survey output (one for each possible answer in multiple-choice questions) to be greatly reduced to one variable for each question. In the case of multiple-choice *range* questions, variables were created where a weighted index substituted several individual options within a range by the centroid of the chosen options. Thus, a final, unified Excel datasheet[1] was built from the database for subsequent analyses containing numerical data.

In addition, 3,883 verbatim, free-text answers and comments[2] were compiled together after translating into English some 1,873 from the original Traditional Chinese (CN-T), Simplified Chinese (CN-S), Spanish (ES), French (FR), and Russian (RU) languages. Where appropriate, some of these answers were in turn coded to gather frequency data, in order to address emergent questions not included within the surveys at the outset.

The unified datasheet was checked for duplicates, errors and mismanagement, and summary statistics and frequency data were compiled (Fig. 3). A number of additional data were collected from other sources for further analysis, e.g. the respondent's city's coordinates were taken from geo-location facilities.

For the majority of the questions, we analysed responses by frequency analyses, either directly on the data variables, or on cross-tabulations among variables. Frequencies were plotted or mapped as appropriate in order to address trends from questions either originally designed in the survey's goals, or emerging from the analytical process.

RESULTS AND DISCUSSION

We will present the main results here along with a short discussion relevant to each result. More detailed discussion of the survey results, in the context of biodiversity conservation challenges, can be found in Faith et al., this volume.

Survey Characteristics

The survey received 750 distinct responses from 77 countries (Table 2). However, most respondents were from Taiwan (157), Spain (124), USA (85), Mexico (64), and Canada (50). Thirty-one countries (40%) provided a single response each. Two-thirds of responses came from developed countries (*advanced economies* as defined by the International Monetary Fund, 2009), the number of responses appearing to be dependent on the economic power of the country (Figs. 4 and 5), although slightly more so on size-dependent wealth (Fig. 5, right) than relative wealth (Fig. 5, left.)

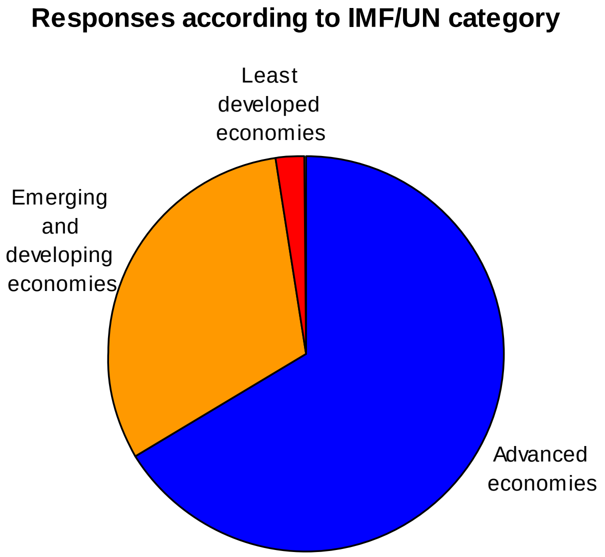

Figure 4: Number of responses received according to the development status of the country. Classes based on the IMF database, 2009, and United Nation's Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and the Small Island Developing States (UN-OHRLLS, 2010.)

[1] The unified Excel datasheet has been archived and is available for further analysis on request.

[2] The full set of 3,883 verbatim, free-text answers and comments has been archived and is available for further analysis on request.

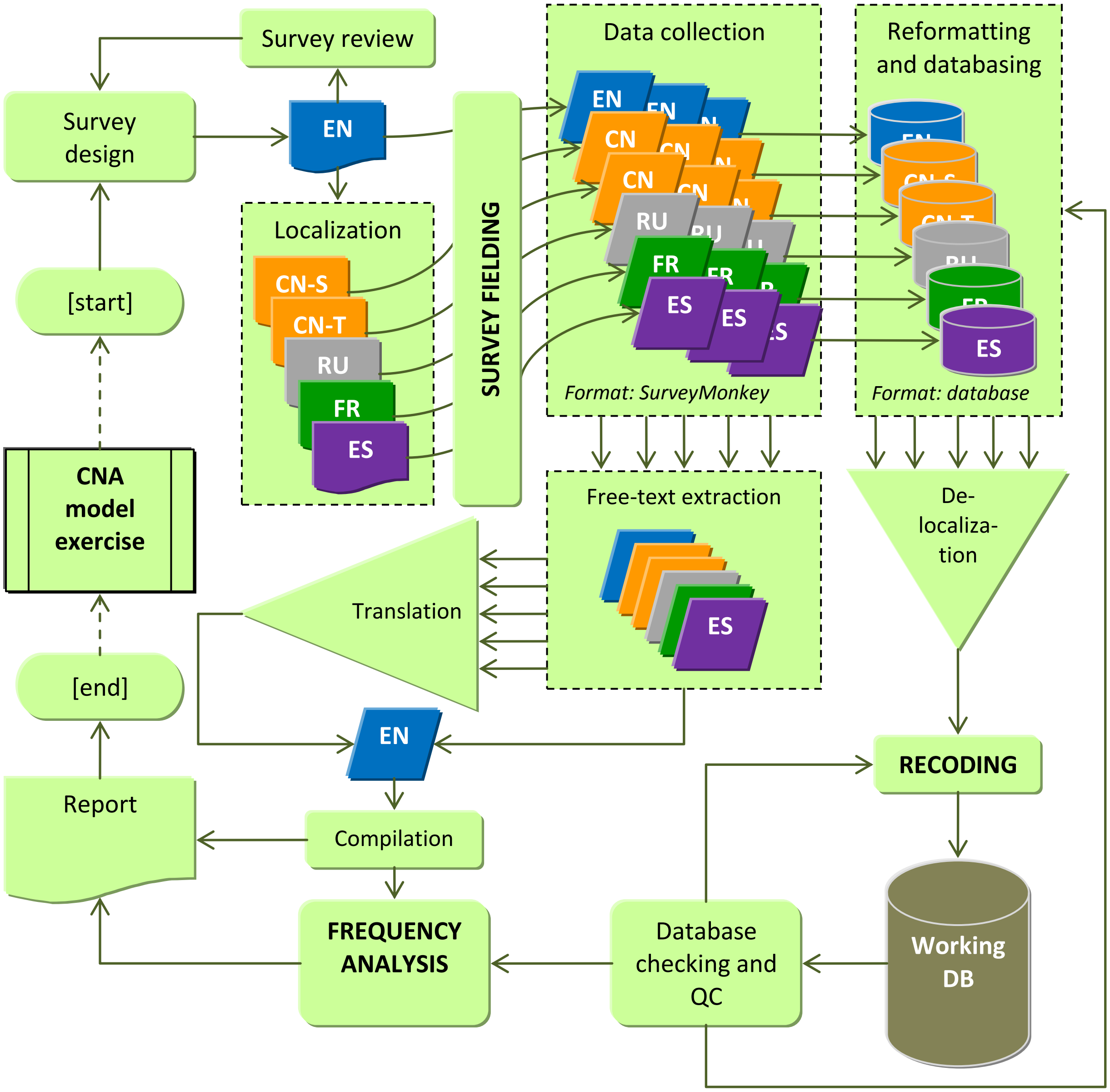

Figure 3: Flow chart of the analytical design for Content Needs Assessment (CNA) Survey. CN-S: Simplified Chinese; CN-T: Traditional Chinese; DB: database; EN: English; ES: Spanish; FR: French; RU: Russian; QC: quality control.

Table 2: List of countries of origin of the received answers and their ISO 3166-1 alpha-3 three-letter code (ISO, 2007.)

Code	Country
ARG	Argentina
AUS	Australia
AUT	Austria
BDI	Burundi
BEL	Belgium
BGD	Bangladesh
BOL	Bolivia
BRA	Brazil
CAN	Canada
CMR	Cameroon
COL	Colombia
COM	Comoros
CRI	Costa Rica
CUB	Cuba
CZE	Czech Republic
CHE	Switzerland
CHL	Chile
CHN	China
DEU	Germany
DNK	Denmark
DOM	Dominican Republic
ECU	Ecuador
EGY	Egypt
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GNQ	Equatorial Guinea
GTM	Guatemala
IDN	Indonesia
IND	India
IRL	Ireland
ISL	Iceland
ISR	Israel
ITA	Italy
JPN	Japan
LBY	Libya
LCA	St. Lucia
LSO	Lesotho
LVA	Latvia
MEX	Mexico
MLI	Mali
MLT	Malta
MUS	Mauritius
MWI	Malawi
NGA	Nigeria
NLD	Netherlands
NOR	Norway
NPL	Nepal
NZL	New Zealand
PAK	Pakistan
PER	Peru
PHL	Philippines
POL	Poland
PRT	Portugal
REU	Réunion
ROM	Romania
RUS	Russia
SCG	Serbia and Montenegro
SGP	Singapore
SLV	El Salvador
SUR	Suriname
SVN	Slovenia
SWE	Sweden
SYC	Seychelles
TGO	Togo
TJK	Tajikistan
TUR	Turkey
TWN	Taiwan
TZA	Tanzania
URY	Uruguay
USA	United States
VEN	Venezuela
VNM	Vietnam
ZAF	South Africa
ZAR	Congo, DRC

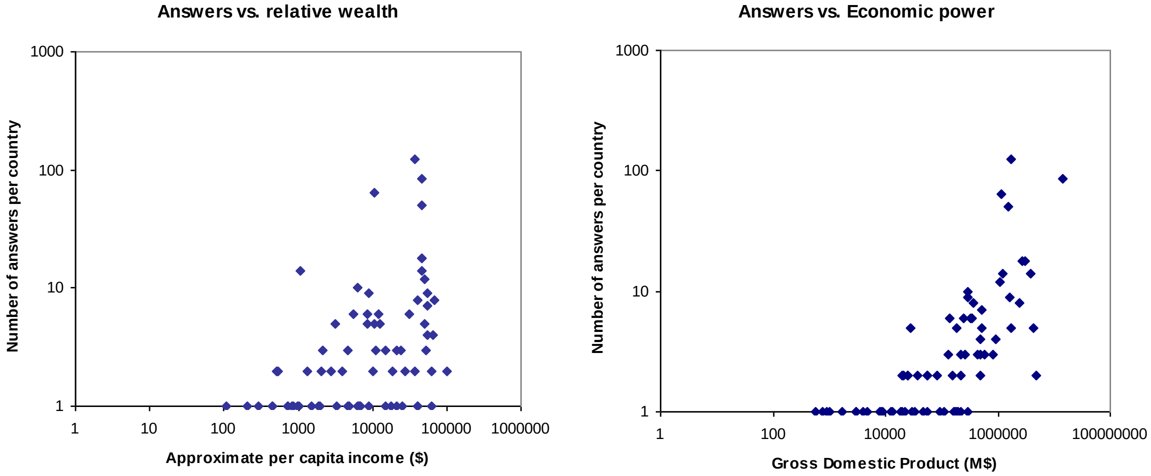

Figure 5: Number of responses according to gross national income per capita and gross domestic product (World Bank, 2010.) Note log scales.

The geographical spread of the respondents is depicted in Figure 6. There is a high concentration of respondents from the northern hemisphere (developed countries), and there are also apparent geographical gaps, such as Russia and China.

Most respondents used the English version (43%), followed by Spanish (32%), Chinese (19%), French (5%), and Russian (1%). Among GBIF participant countries, 38 responded and provided most responses (89%), representing 50% of all responding countries, although about half of the participants provided very few responses, less than five each: CHE, NLD, AUT, CZE, IDN, PER, POL, PRT, CMR, EGY, EST, ISL, JPN, NOR, SVN, TZA, CRI, IRL, PAK, PHL. Furthermore, eleven GBIF participant countries did not respond: BEN, BGR, GHA, GIN, KOR, MDG, MAR, NIC, PNG and SVK (Fig. 7).

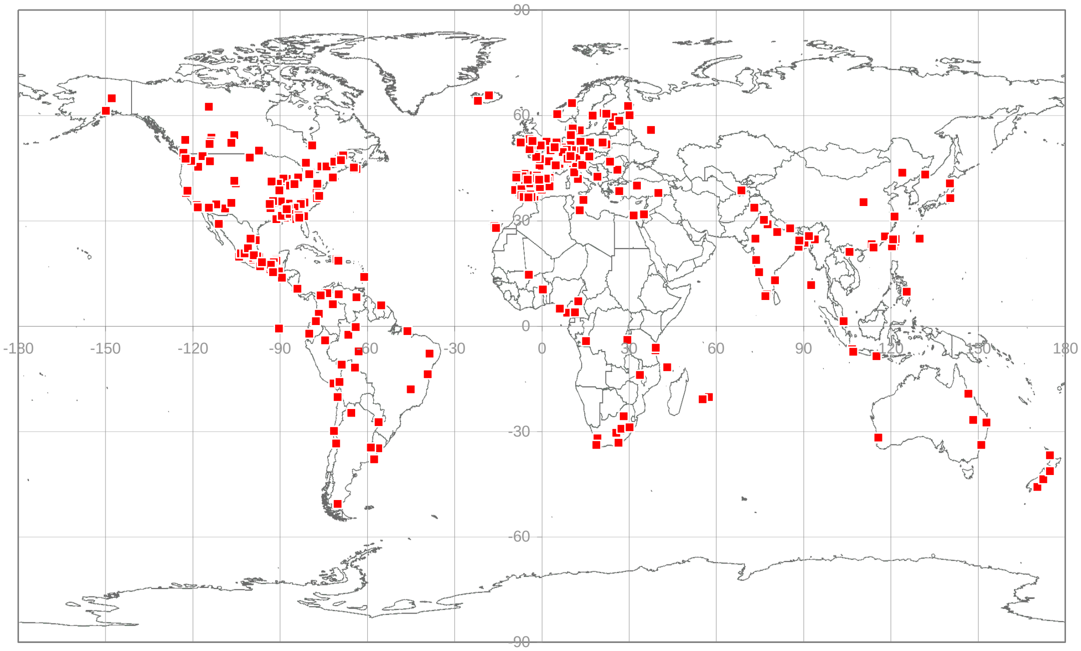

Figure 6: Geographical location of respondents. Each dot represents one or more respondents.

In general, respondents appear to have used their own language to respond the survey (table 3), although some did select the EN version even though a localised version was available. In fact, the most common assumed (vernacular, official, or widely used in the country of origin) language among all respondents was Spanish (242 respondents, vs. 197 English speakers). It seems therefore apparent that the translation effort resulted in a higher turnout for the survey than if it had been in EN only.

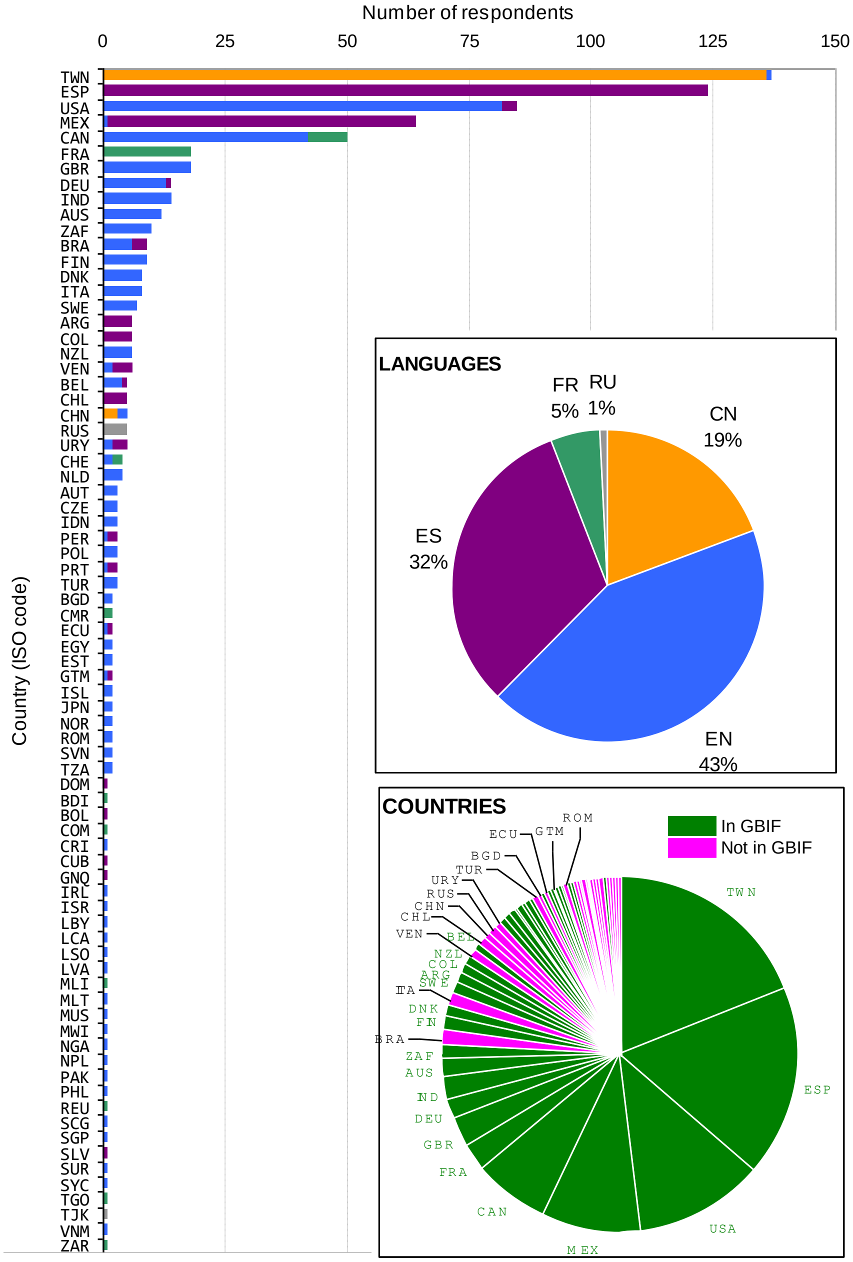

Figure 7: Breakdown of respondents per language and country.

A comparison with a similarly-circulated survey by the Global Strategy and Action Plan for the Digitisation of Natural History Collections Task Group that was issued in EN only (Berendsohn et al., 2010; Vollmar et.al., 2010) shows that non-English speakers were much less responsive when lacking the localised surveys (Figure 8).

Table 3: Percent of speakers of a main language (rows) using the language-specific survey (columns) in the CNA survey.

Assumed language of	Language of survey				
respondent	EN	ES	CN	FR	RU
EN	185	3	0	8	1
ES	21	221	0	0	0
CN	4	0	141	0	0
FR	2	0	0	28	0
RU	0	0	0	0	5
OTHER	97	7	0	0	1

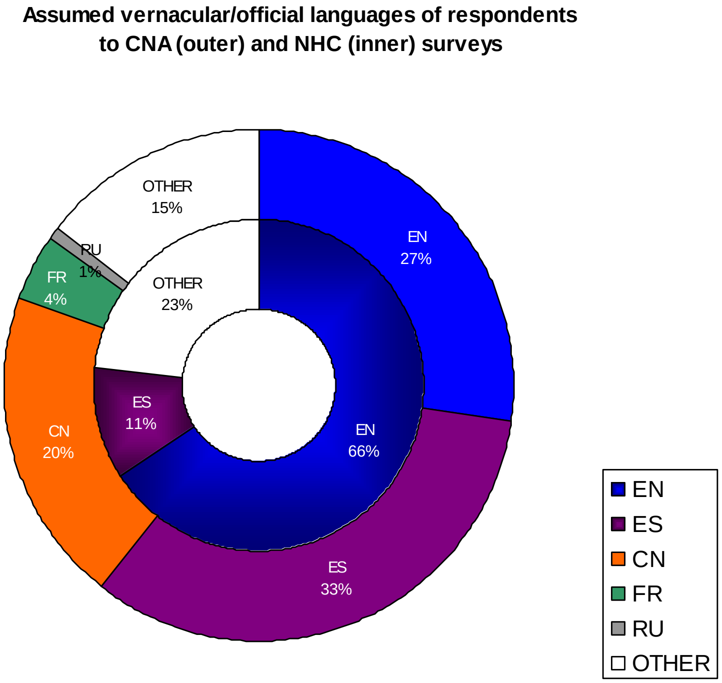
Assumed vernacular/official languages of respondents to CNA (outer) and NHC (inner) surveys

Figure 8: Comparison between the assumed languages (vernacular, official, or widely used in the country of residence) of more than 700 respondents to the CNA survey (outer ring) and more than 200 respondents to the GSAP-NHC survey (inner ring). CNA respondents could choose among six different surveys (EN, ES, CN-S, CN-T, FR, RU; for simplicity, both Chinese surveys, traditional and simplified, have been merged here). GSAP-NHC respondents were issued only an EN version. Respondents were less responsive to the EN-only survey. For example, no responses to the GSAP-NHC survey came from RU, FR or CN-speaking countries, and the ES response was much higher when an ES survey was available. In the GSAP survey, "OTHER" includes the following languages in descending frequency order: NL, SV, PT, DE, DA, FI, IT, MS, AR, HE, JA, SQ, UR. (ISO 639-1 codes.)

Although countries mobilizing more data were also providing more responses, some countries had a very low turnout, with three or less responses each: CRI, ISL, JPN, NOR, SVN, AUT, PER, POL, PRT (Figure 9). One of the GBIF participant countries (South Korea) did mobilize data but did not provide any responses, but 49 non-participant countries did provide responses (Fig. 10): BDI, BGD, BOL, BRA, CHL, CHN, CMR, COL, COM, CUB, CZE, DOM, ECU, EGY, EST, GNQ, GTM, IDN, IND, IRL, ISR, ITA, LBY, LCA, LSO, LVA, MLI, MLT, MUS, MWI, NGA, NPL, PHL, REU, ROM, RUS, SGP, SLV, SUR, SYC, TGO, TJK, TUR, TZA, URY, VEN, VNM, ZAF, ZAR.

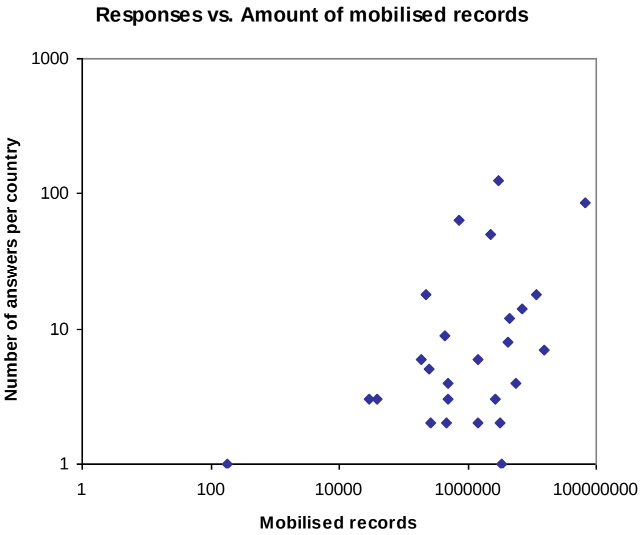

Figure 9: Responses from GBIF participant countries vs. volume of data mobilization (GBIF, 2009.)

The above results, especially the low turnout from a number of GBIF participant countries, suggest a need for improved coordination by the GBIF participant nodes in conducting similar surveys. This highlights the gains for GBIF as a community to be made from improved outreach and public relations.

Most of the survey respondents were academic (45%) or research (26%) (Figure 11), but surprisingly, NGOs were poorly represented (5%). This suggests that either NGOs were not sampled adequately, or the NGOs do not actually use the type of data mobilised by GBIF.

68 respondents (9%) specified other types or made clarifications, although most could actually be included within the predefined types. The most common "other" types listed were those related with the administration or national, state, or county government (27) and museums, herbaria or botanical gardens (15), although many also included this institution within Academic or Research institution. A number of respondents made clarifications because it was not possible to tick more than one predefined answer.

The majority of the respondents were active within biodiversity research (69%) or conservation science (59%), including taxonomic research (because the survey here posed a multiple-choice question, respondents could select more than one area). A second group of interest included management and education, chosen each by one-third of the respondents (Figure 12).

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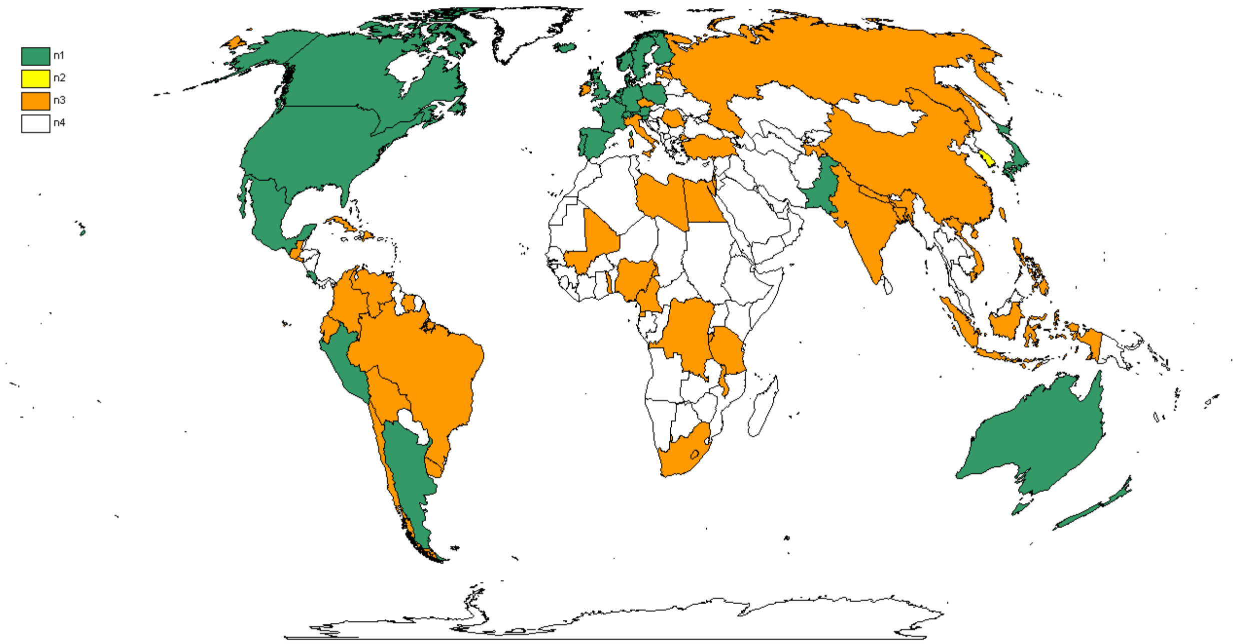


Figure 10: Countries mobilising data through GBIF network (GBIF, 2009) vs. countries providing responses. Green: Mobilising and responding; yellow: mobilising but not responding (KR); saffron: responding but not mobilising; blank: neither mobilising nor responding.

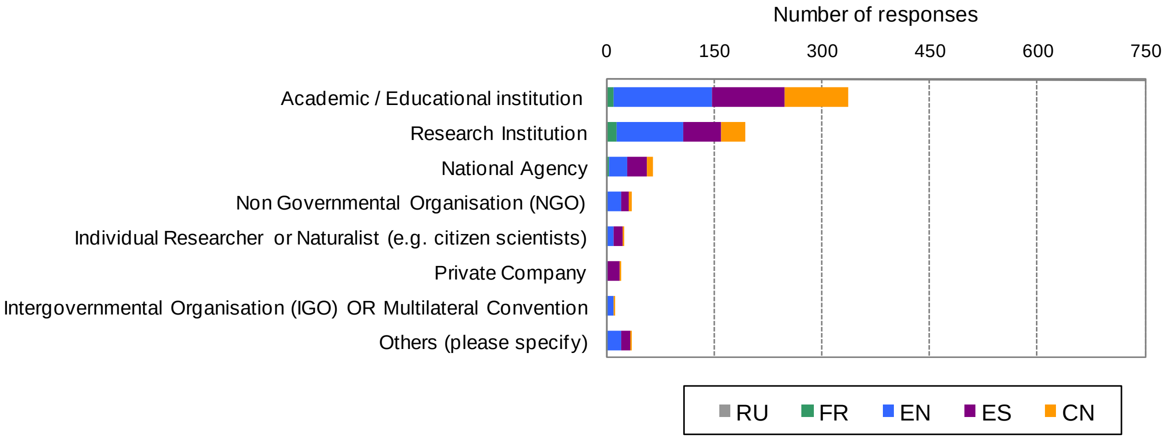


Figure 11: Organisations that responded to survey (Table 1: User Profile –Q2.)

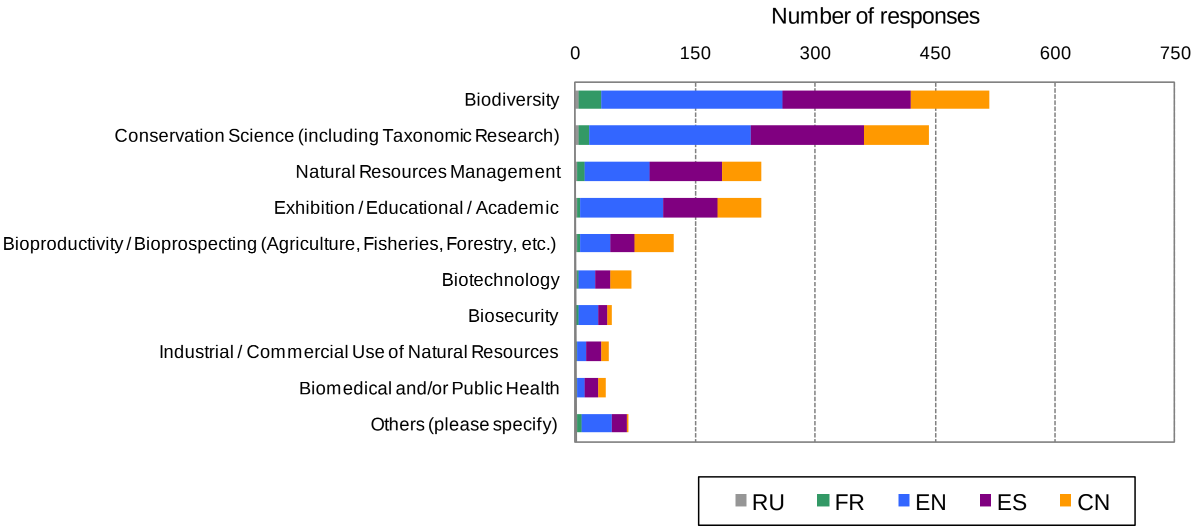
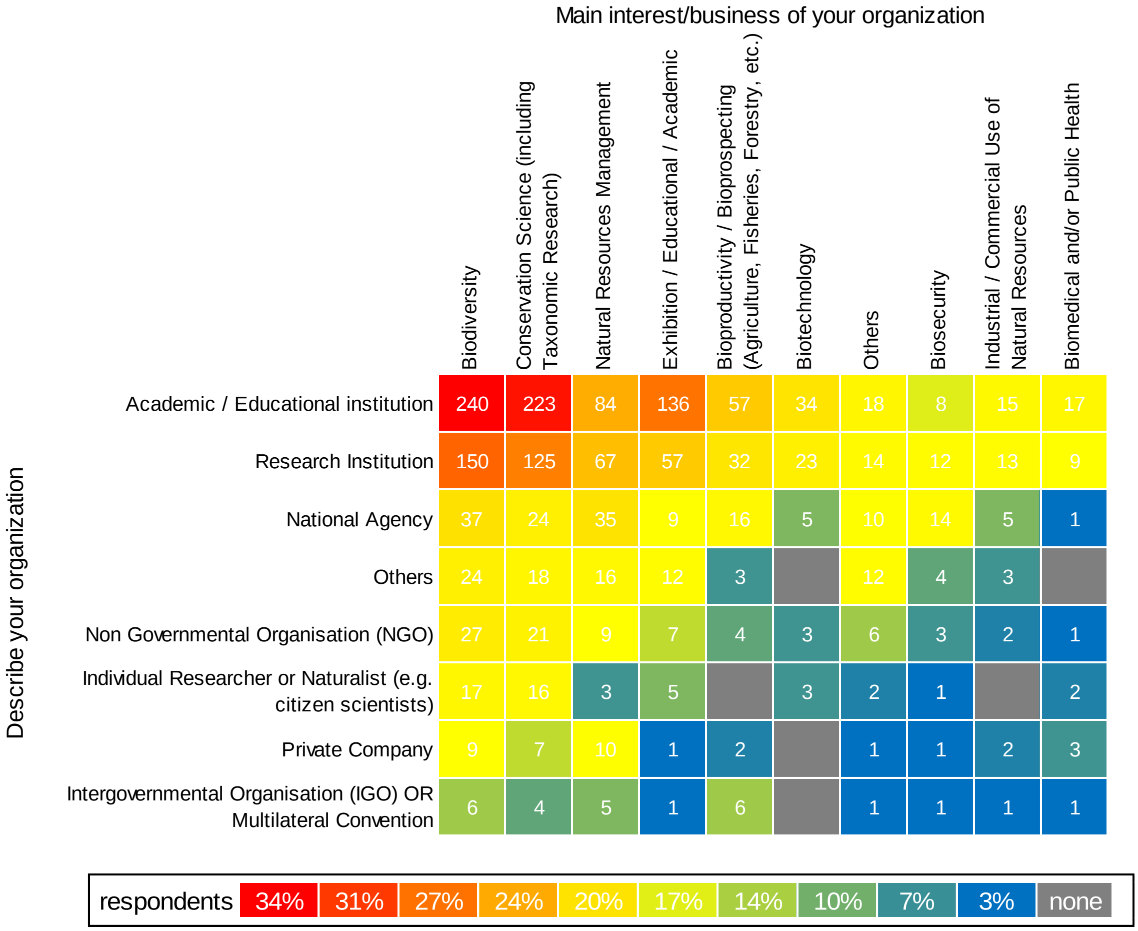


Figure 12: Main interest/business of respondent organisations. More than one option was available to each respondent.



Main interest/business of your organization

Describe your organization

	Biodiversity	Conservation Science (including Taxonomic Research)	Natural Resources Management	Exhibition / Educational / Academic	Bioproductivity / Bioprospecting (Agriculture, Fisheries, Forestry, etc.)	Biotechnology	Others	Biosecurity	Industrial / Commercial Use of Natural Resources	Biomedical and/or Public Health
Academic / Educational institution	240	223	84	136	57	34	18	8	15	17
Research Institution	150	125	67	57	32	23	14	12	13	9
National Agency	37	24	35	9	16	5	10	14	5	1
Others	24	18	16	12	3		12	4	3	
Non Governmental Organisation (NGO)	27	21	9	7	4	3	6	3	2	1
Individual Researcher or Naturalist (e.g. citizen scientists)	17	16	3	5		3	2	1		2
Private Company	9	7	10	1	2		1	1	2	3
Intergovernmental Organisation (IGO) OR Multilateral Convention	6	4	5	1	6		1	1	1	1

Figure 13: Correspondences between type of institution and their main interests (Table 1: User Profile – Q2 & Q3.)

A few respondents (3%) chose not to select any predefined answer but supplied an alternate definition. However, most of these answers could fit within the predefined categories (see Annex). Some exclusive answers that appeared very focused and could not be readily fit in other categories were: "application of environmental regulations"; "environmental policy and legislation"; "software development"; "sustainable design and construction"; "to promote environmental care and sustainable development".

Educational/academic institutions seem proportionally more related to biodiversity and conservation science than their administration counterparts. NGOs, in turn, seem more committed to this research or activity. Management also lies within the administration, but not so much bioproductivity. (Figure 13).

USES OF PRIMARY BIODIVERSITY DATA:

Using primary biodiversity data (Q01)

Results of the survey (Figure 14) show that there are three broad categories of uses for biodiversity data:

1. *Basic science*, as represented by Taxonomy, Diversity, Population Dynamics, Biogeography, Ecology, Evolution. These represent the majority of the uses.
2. *More applied science*, such as genetics, endangered species, studies dealing with migrations and invasions, conservation planning, natural resources management, environmental impact management or climate change impact.

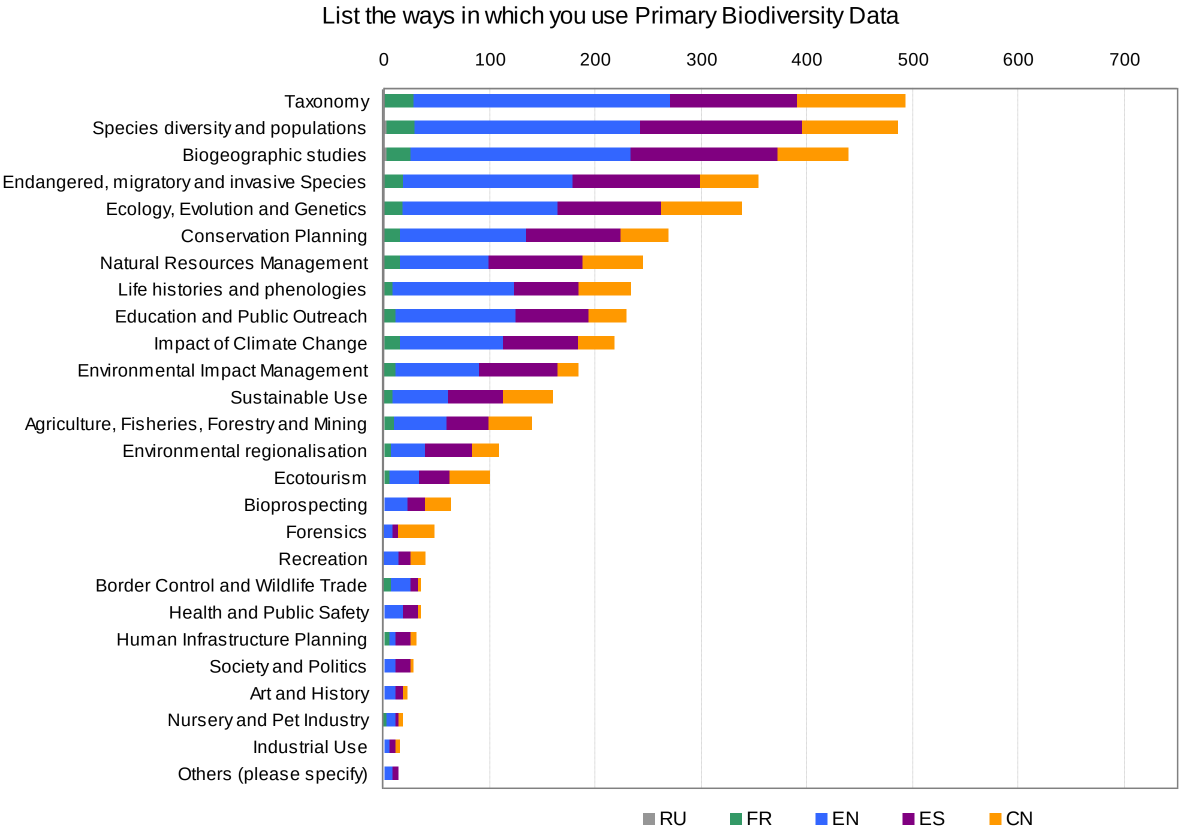


Figure 14: Uses of Primary biodiversity data. Frequency of responses to Q01: "List the ways in which you use primary biodiversity data" (Table 1.)

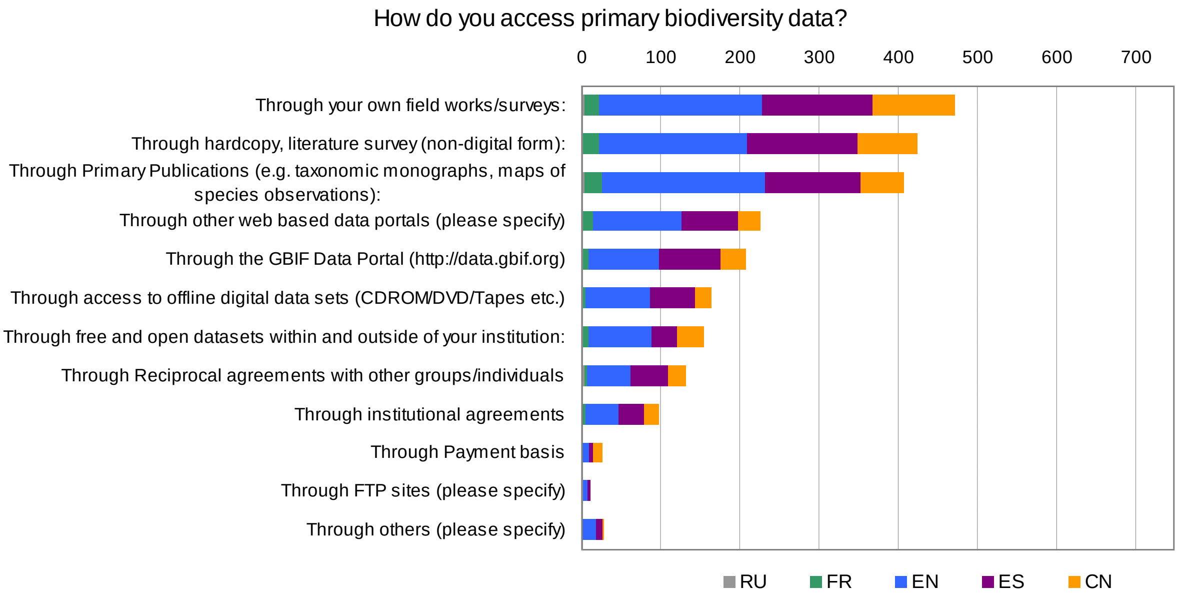


Figure 15: Modes of access to primary biodiversity data. Frequency of responses to Q03: "How do you access primary biodiversity data?" (Table 1.)

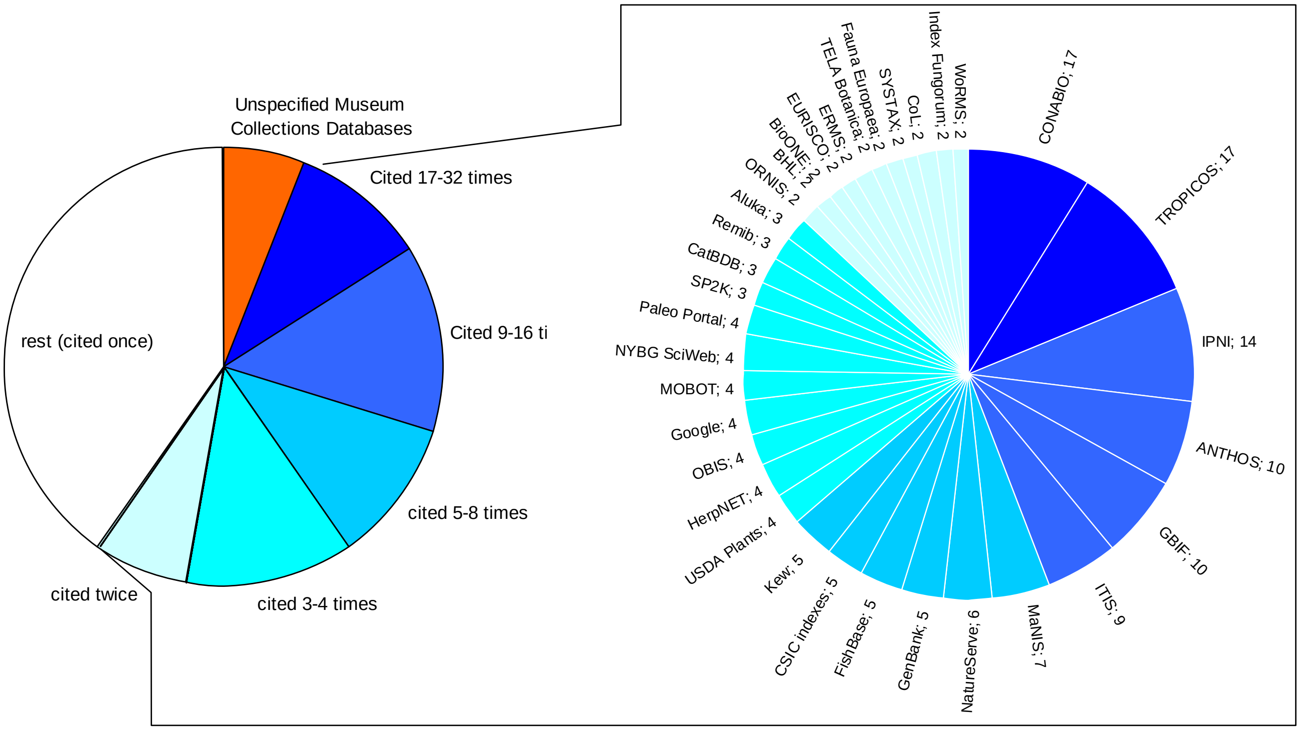


Figure 16: Breakdown of database-type access to primary biodiversity data that were specified by 173 respondents.

3. *Societal issues*, such as ecotourism, recreation, public health, infrastructure planning, etc. These have a low representation overall.

These results must be viewed in the light of the types of respondents, which were heavily biased towards research/academic institutions. This accounts for numerous respondents' links to basic science.

(a) *Accessing data (Q03)*

Two main categories can be distinguished here (Figure 15). First, data that are deemed trustworthy: one's own data collected from field work, or surveys, and peer-reviewed data collected from literature. Second, data sources assumed to be "less reliable" (because of potential lack of quality checks such as in a peer review, or because of intrinsic lack of confidence in other's data), such as web portals (including GBIF data portal) and other digital data sources.

One-third of the respondents used GBIF data, either directly from the GBIF data portal, or similar access points. Therefore, the remaining two-thirds of the respondents who use other resources define a group of potential future contributors to GBIF (although many of them might be actually using GBIF data as many of these portals are indeed associated with GBIF). The fact that the majority of respondents were using portals other than GBIF data portal may suggest that national, regional or thematic data portals should be encouraged as part of the GBIF community.

Respondents answering the previous question were asked to provide detailed data. More than two hundred (209) respondents provided sources[3] of which 173 supplied 316 databased/electronic sources. Figure 16 summarises these sources. This breakdown allows us to see both the relative importance of online sources, and what sources could eventually be most 'profitably' targeted by GBIF for integration

Different types of users tend to use different access mechanisms (Figure 17). For example, systematists tend to use data originating through their own work program. Access through GBIF (green in Fig. 17) follows, in general, the same pattern as for other on-line data sources. Most access of GBIF data appears to be related to "hard"-science, i.e. taxonomy, biogeography, biodiversity, etc. However, the percentage oriented in this way is not as great as that for traditional access means (own/field work, hardcopy literature, etc.)

Frequency of access (Q04)

The majority of the respondent users were not able to determine the frequency of access (Figure 18). However, nearly two hundred respondents indicated that they access data on a daily basis. Further, another one hundred did so on a monthly basis.

The breakdown of the frequency of access according to different uses of data (Figure 19) shows that basic science data require access more frequently, along with outreach and environmental impact management needs.

Together, these findings may indicate what fraction of users appear to be depending on data availability.

Multiple access points (Q05)

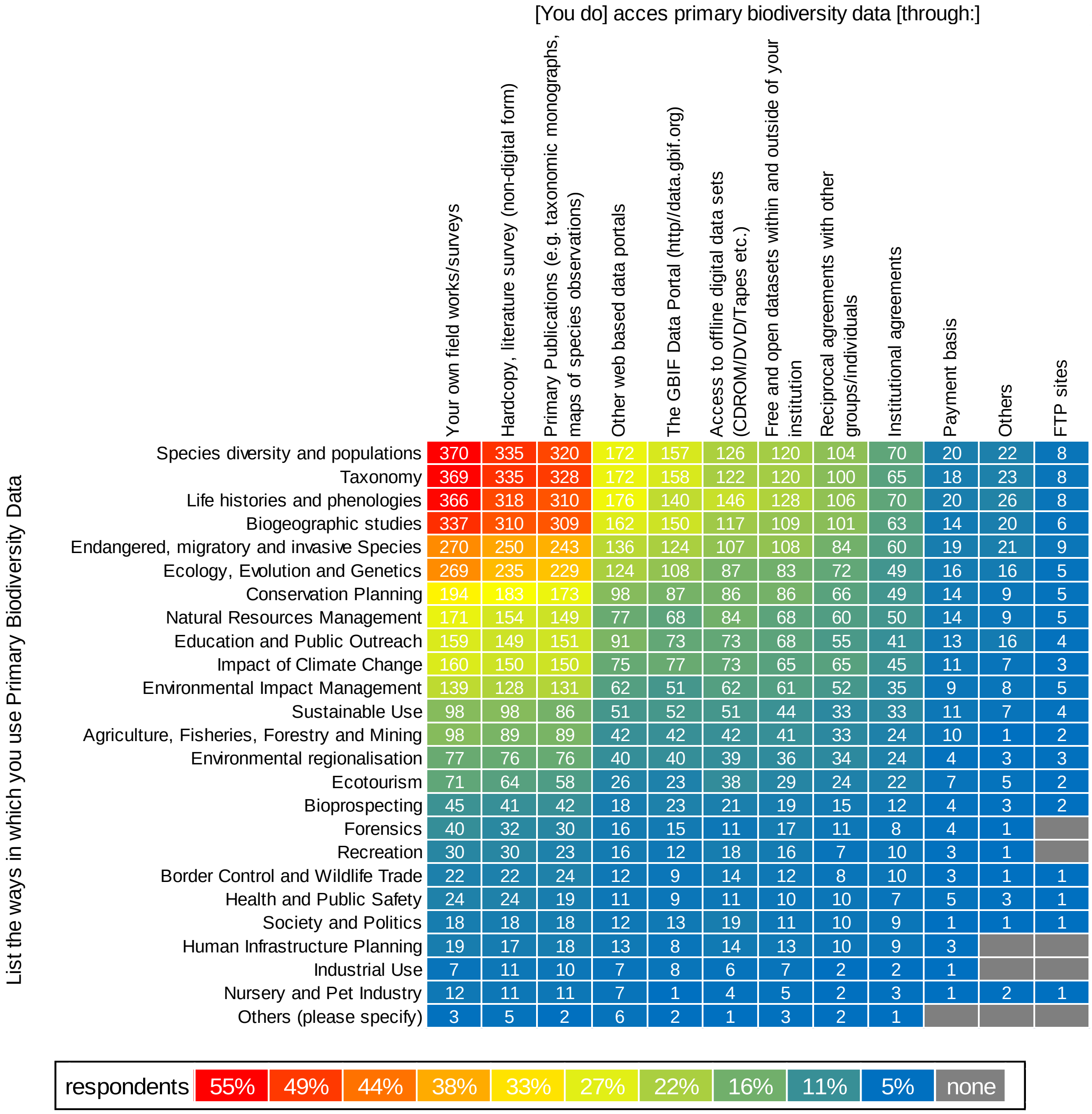
Although about one fourth of users like to use more than one data portal (Figure 20), the survey results indicate that most users have their own preferred data portal. Among these, the majority of the preferred, sole-use, portals is the GBIF data portal.

Using other data access points (Q06)

Among the reasons that respondents put forward for accessing data portals other than GBIF, "tradition" was the most frequently cited (Figure 21). It should be noted in this context that many data portals existed even before GBIF data portal was put in place. Thus, "tradition" reflects the "head start" gained by some data portals ("why should I go somewhere else?"). It is noteworthy that a widespread lack of awareness of the GBIF data portal is revealed by the survey results. Further, the survey reveals that some users are choosing other data portals because of "ease of use".

[3] At the time of publishing of this report, these will be archived and made available for further analysis on request.

There were 62 respondents (9% of total) providing textual reasons, often under the “other” option in the survey. A noteworthy outcome was that new, unforeseen reasons were put forward (Figure 22). The most frequent reason provided qualifications on the basic rationale that it is better to use “known systems” (tradition). However, a number of responses point to GBIF portal performance/design issues (15 respondents), or the data quality, coverage, or adequacy (23 respondents). This suggests that the data quality for other access points, as well as breadth, depth, richness and granularity, may be higher than that of the GBIF data portal.



	Your own field works/surveys	Hardcopy, literature survey (non-digital form)	Primary Publications (e.g. taxonomic monographs, maps of species observations)	Other web based data portals	The GBIF Data Portal (http//data.gbif.org)	Access to offline digital data sets (CDROM/DVD/Tapes etc.)	Free and open datasets within and outside of your institution	Reciprocal agreements with other groups/individuals	Institutional agreements	Payment basis	Others	FTP sites
Species diversity and populations	370	335	320	172	157	126	120	104	70	20	22	8
Taxonomy	369	335	328	172	158	122	120	100	65	18	23	8
Life histories and phenologies	366	318	310	176	140	146	128	106	70	20	26	8
Biogeographic studies	337	310	309	162	150	117	109	101	63	14	20	6
Endangered, migratory and invasive Species	270	250	243	136	124	107	108	84	60	19	21	9
Ecology, Evolution and Genetics	269	235	229	124	108	87	83	72	49	16	16	5
Conservation Planning	194	183	173	98	87	86	86	66	49	14	9	5
Natural Resources Management	171	154	149	77	68	84	68	60	50	14	9	5
Education and Public Outreach	159	149	151	91	73	73	68	55	41	13	16	4
Impact of Climate Change	160	150	150	75	77	73	65	65	45	11	7	3
Environmental Impact Management	139	128	131	62	51	62	61	52	35	9	8	5
Sustainable Use	98	98	86	51	52	51	44	33	33	11	7	4
Agriculture, Fisheries, Forestry and Mining	98	89	89	42	42	42	41	33	24	10	1	2
Environmental regionalisation	77	76	76	40	40	39	36	34	24	4	3	3
Ecotourism	71	64	58	26	23	38	29	24	22	7	5	2
Bioprospecting	45	41	42	18	23	21	19	15	12	4	3	2
Forensics	40	32	30	16	15	11	17	11	8	4	1	
Recreation	30	30	23	16	12	18	16	7	10	3	1	
Border Control and Wildlife Trade	22	22	24	12	9	14	12	8	10	3	1	1
Health and Public Safety	24	24	19	11	9	11	10	10	7	5	3	1
Society and Politics	18	18	18	12	13	19	11	10	9	1	1	1
Human Infrastructure Planning	19	17	18	13	8	14	13	10	9	3		
Industrial Use	7	11	10	7	8	6	7	2	2	1		
Nursery and Pet Industry	12	11	11	7	1	4	5	2	3	1	2	1
Others (please specify)	3	5	2	6	2	1	3	2	1			

Figure 17. Correspondences between declared uses of primary biodiversity data and approaches to access them: Cross-frequencies of Q01 and Q03 (Table 1.)

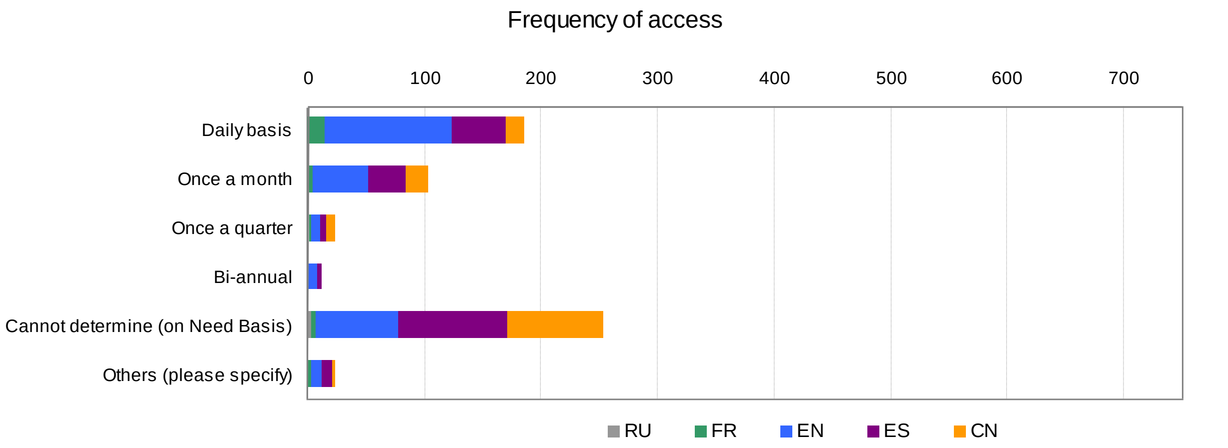
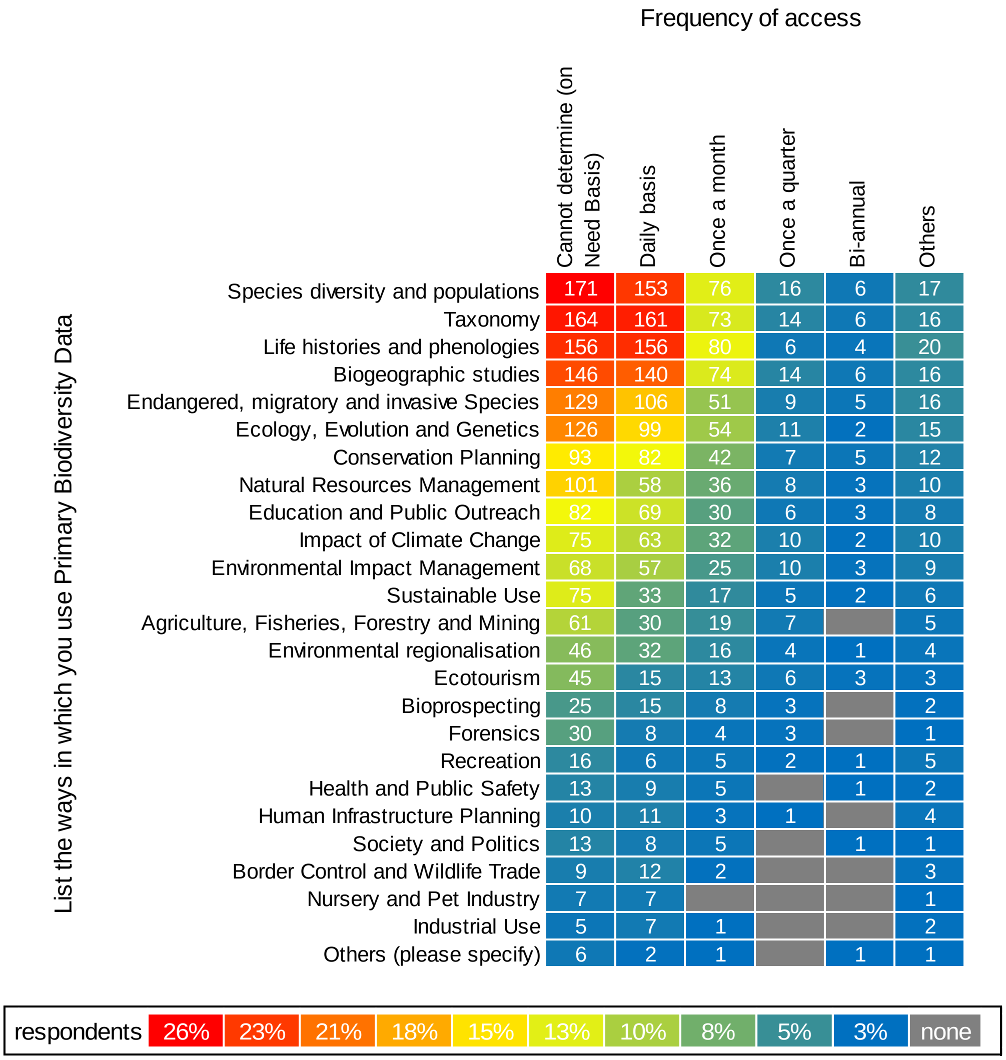


Figure 18: Frequency of access to biodiversity data. Frequencies of responses to Q04: “Frequency of access” (Table 1.)


Frequency of access
List the ways in which you use Primary Biodiversity Data

	Cannot determine (on Need Basis)	Daily basis	Once a month	Once a quarter	Bi-annual	Others
Species diversity and populations	171	153	76	16	6	17
Taxonomy	164	161	73	14	6	16
Life histories and phenologies	156	156	80	6	4	20
Biogeographic studies	146	140	74	14	6	16
Endangered, migratory and invasive Species	129	106	51	9	5	16
Ecology, Evolution and Genetics	126	99	54	11	2	15
Conservation Planning	93	82	42	7	5	12
Natural Resources Management	101	58	36	8	3	10
Education and Public Outreach	82	69	30	6	3	8
Impact of Climate Change	75	63	32	10	2	10
Environmental Impact Management	68	57	25	10	3	9
Sustainable Use	75	33	17	5	2	6
Agriculture, Fisheries, Forestry and Mining	61	30	19	7		5
Environmental regionalisation	46	32	16	4	1	4
Ecotourism	45	15	13	6	3	3
Bioprospecting	25	15	8	3		2
Forensics	30	8	4	3		1
Recreation	16	6	5	2	1	5
Health and Public Safety	13	9	5		1	2
Human Infrastructure Planning	10	11	3	1		4
Society and Politics	13	8	5		1	1
Border Control and Wildlife Trade	9	12	2			3
Nursery and Pet Industry	7	7				1
Industrial Use	5	7	1			2
Others (please specify)	6	2	1		1	1

respondents	26%	23%	21%	18%	15%	13%	10%	8%	5%	3%	none

Figure 19: Types of uses of data and their frequency of access: Cross-frequency of Q01 and Q04.

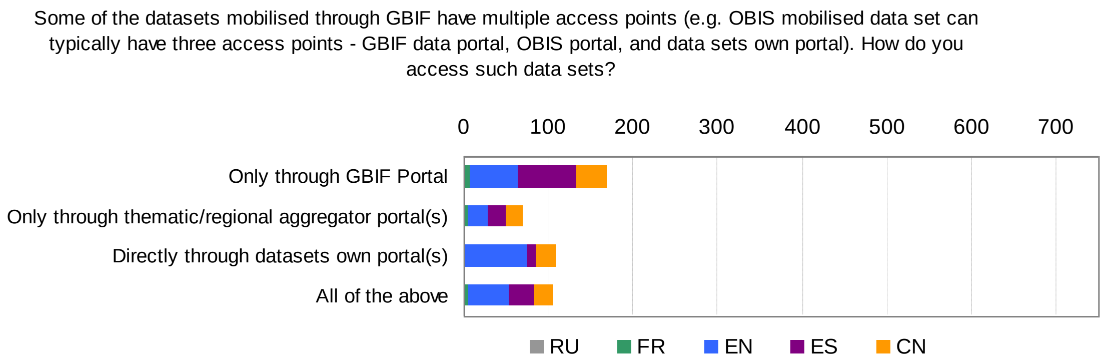


Figure 20: Multiple access points. Frequencies of responses to Q05: “Some of the datasets mobilised through GBIF have multiple access points. How do you access such data sets?” (Table 1.)

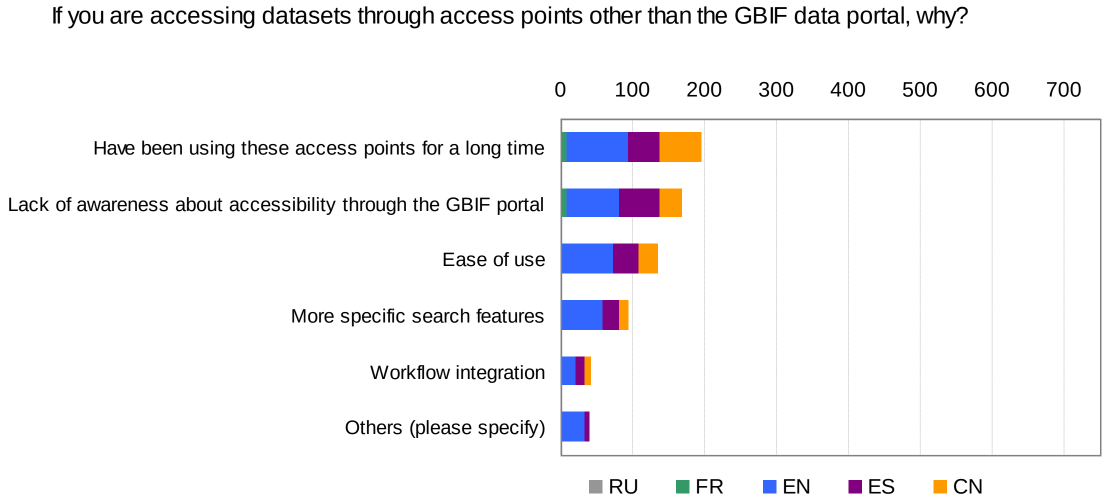


Figure 21: Reasons for accessing data through access points other than GBIF: Frequencies of responses to Q06: “If you are accessing datasets through access points other than the GBIF data portal, why?” (Table 1.)

Data formats (Q07, Q08)

A large user community would continue to use the popular Excel sheet that has become a *de facto* standard for small world data keeping (“simple is better”). On the opposite side of the spectrum, specialty database formats were not highlighted by respondents (Figure 23).

A surprisingly high percentage of users would be using maps as images, or would like to have PDF files available from the portals. As these formats lend themselves poorly to data analysis, this suggests that these users simply want already-processed output that will be used without any further processing. This highlights well the need for continuous improvement of the data portal.

Forty-five respondents specified formats other than predefined, with a majority favouring Access (17) and GIS shape files (10). Also, a demand for shape files or GIS layers could be identified (Figure 24).

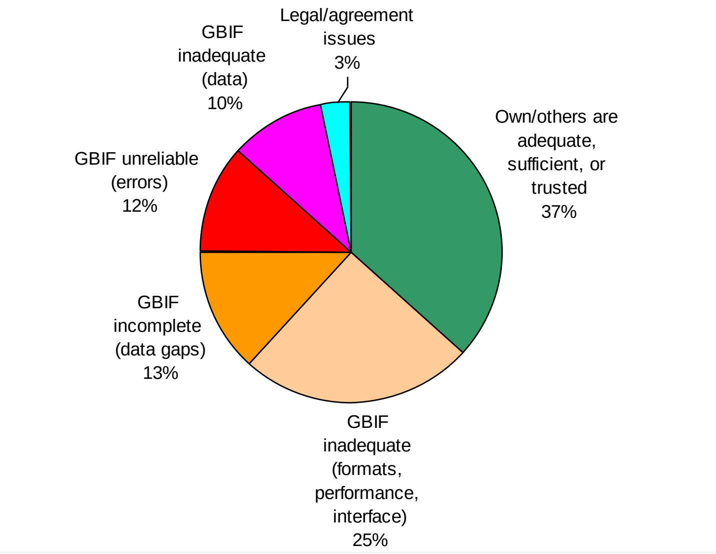


Figure 22: Breakdown of 62 free-text answers to the question related to reasons for accessing data through access points other than GBIF, after recoding (Q04, last option; Table 1.)

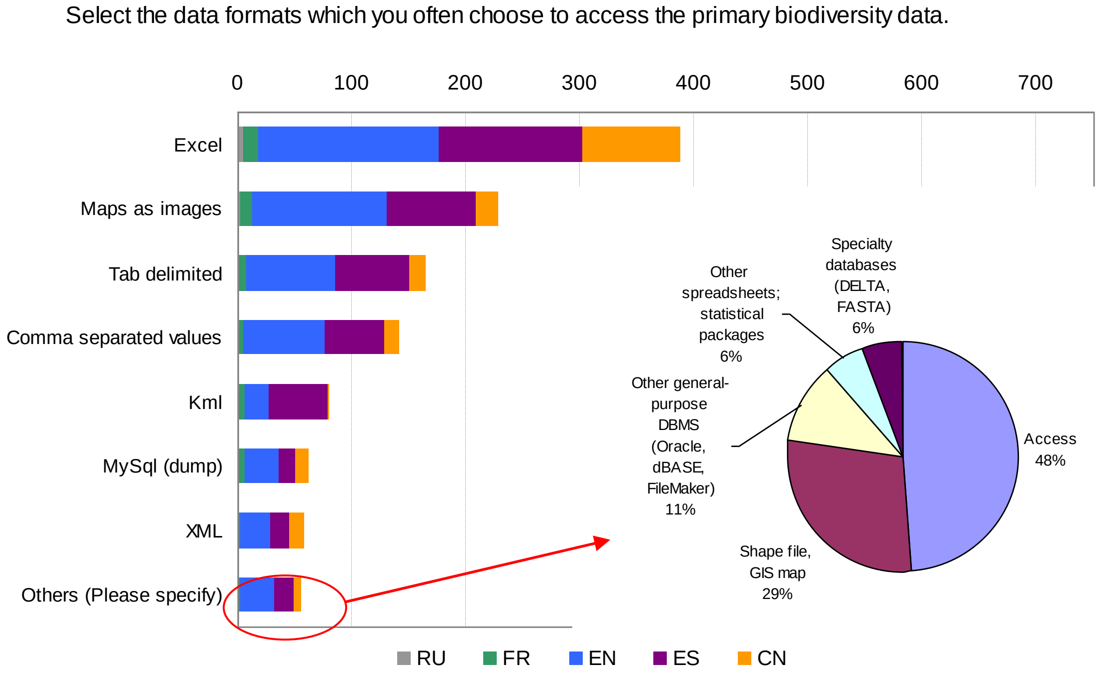


Figure 23: Data formats for accessing data. Frequencies of responses to Q07: “Select the data formats which you often choose to access the primary biodiversity data” (Table 1.)

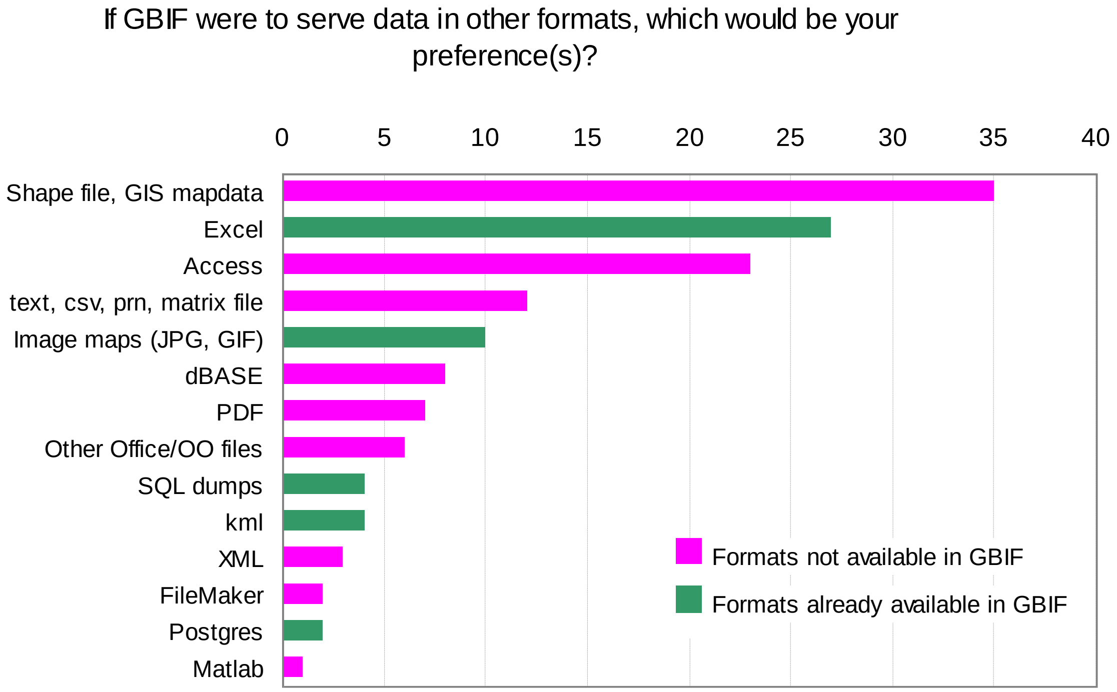


Figure 24: Other data formats potentially required from GBIF. Frequencies of responses to Q08: "If GBIF were to serve data in other formats, which would be your preference?" (Table 1.)

Other types of data (Q09)

When asked to list what other types of data are used along with primary biodiversity data, three broad groups are evident (Figure 25): (i) Geographically-explicit data, including satellite and aerial imagery and related data, environmental data, and land use/infrastructures data (the most sought after); (ii) Species- or habitat-related ecological and taxonomical data; (iii) other specialty data (molecular, genetics, collection and methods, historical, etc.)

QUALITY AND QUANTITY REQUIREMENTS

Primary biodiversity data required (Q10, Q11)

More than two thirds of respondents required taxon names to be included among the retrieved data (Figure 26), either because of the respondents' disciplinary biases (a majority of biodiversity-related scientists) or because data meaning or usefulness would require some type of taxonomic ascription. This result is not surprising given that it has been recognized worldwide that the reliance on a correct name is absolute.

Occurrence data, and descriptive data about the species, both naturally linked to the taxon identifier, are the second group of required data. Together, these two types of data appear to form the core of "biodiversity data".

A more specific type of data appears as a third requirement: distribution data that may be used for modelling, such as occurrence data (including absence data), and population and population interaction data.

Respondents free-texting "Others" offered a wide range of options, although most could actually be included within the pre-defined types (Fig. 27). Among the particular types (but always with low frequency) were some that might not be properly considered primary biodiversity data, such as "risk status", "invasiveness" or "interactive keys" (see Annex for a full list). It is illustrative to observe the importance given to certain types by certain language-specific surveys, such as “Conservation/Risk” or “Habitat data”.

Respondents seemed to agree that for their uses, hundreds to thousands of PBRs seemed adequate (Fig. 28) although requirements varied with the type of data: The biggest requirement seemed to be occurrence records, presumably for species monitoring programmes (1,000 datapoints). Multimedia resources are required in less quantities, about 500 on average.

Data-intensive environments (Q12, Q13)

Participants were asked to identify which environments consumed more PBR in their experience. Terrestrial environments dominate among respondents (Fig. 29), and more so for mountain environments and temperate forests. This plot, however, may also reflect the transect across the interest fields of respondents, or might eventually depict the composition of the scientific body related to primary biodiversity data. It is significant, though, that the lowest frequency lies in deserts and deep seas (harsh environments).

Given that the set of respondents was not randomly stratified over different environment-types or biomes, we cannot draw conclusions about the most important, highest priority, context for new data requirements. Nevertheless, the results do show that, no matter what the environment/habitat of interest, there is a general call for more/better primary biodiversity data.

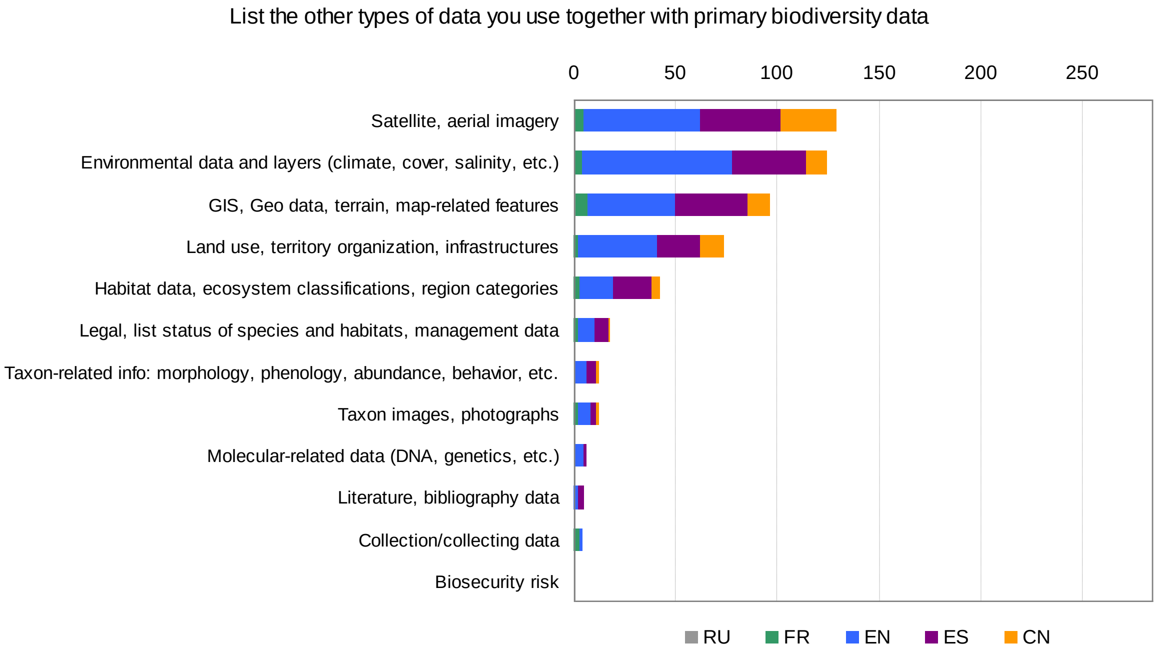


Figure 25: Types of data that are used along with primary biodiversity data (Table 1, Q09: “List the other types of data you use together with primary biodiversity data?”). Respondents could use free-text and specify several types each. Responses[4] have been recoded into frequently-mentioned categories, or ascribed to them.

[4] These 284 verbatim answers have been archived and are available for further analysis on request.

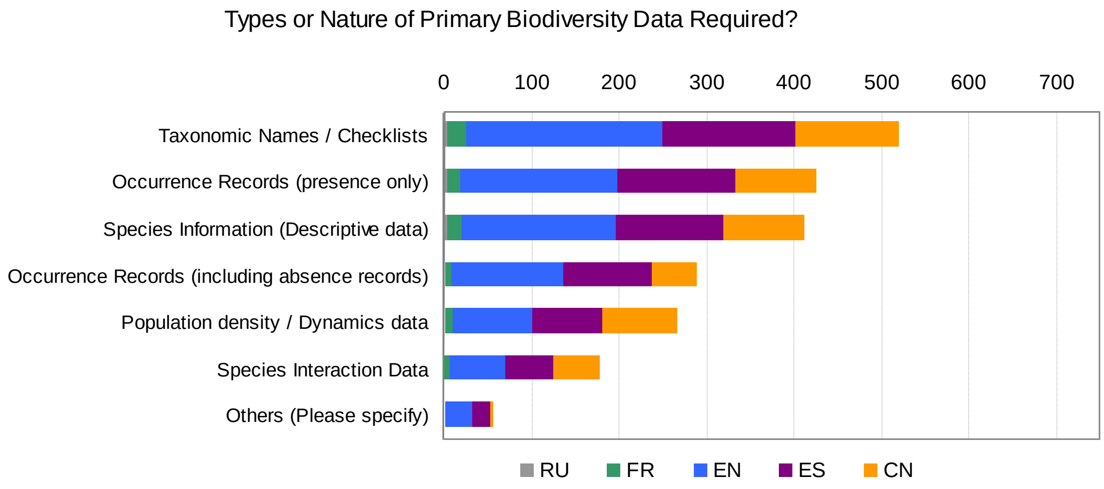


Figure 26: Types of primary biodiversity data required. Frequencies of respondents to Q10: "Types or nature of Primary Biodiversity Data required?" (Table 1.)

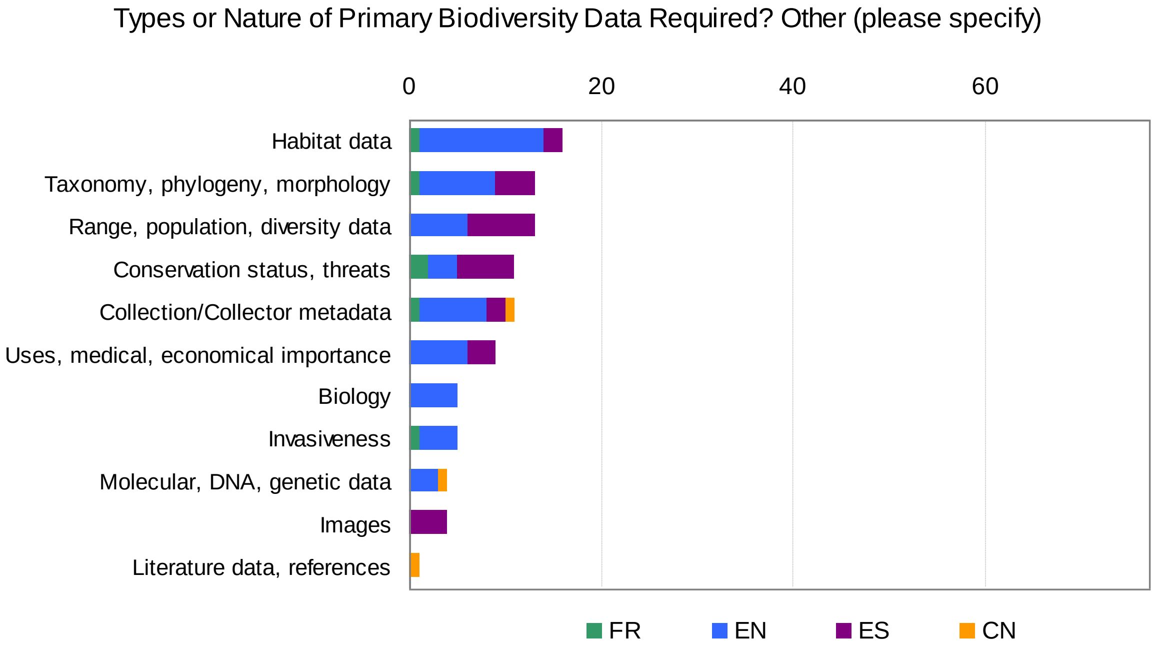


Figure 27: Composition of the "new data types", listed under "Others" in Q10 (Fig. 26), and described by 77 respondents (Table 1 and Annex).

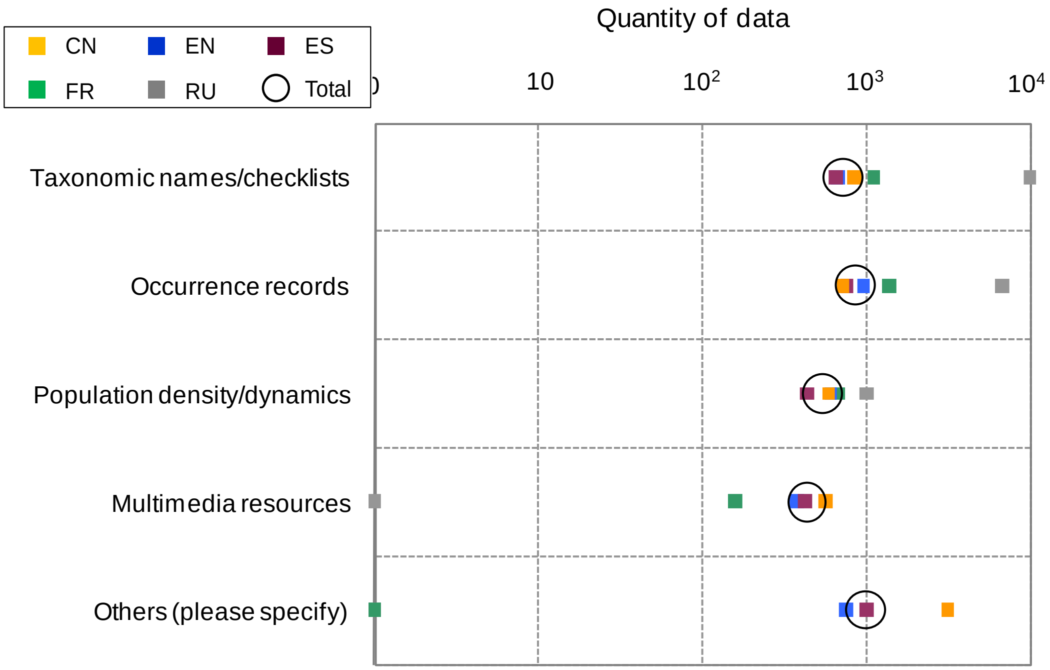


Figure 28: Average quantity of data required for each type (Table 1, Q11: "Quantity of data required for each type?"). Each respondent was given a choice of order-of-magnitude levels, but could select multiple levels. To allow comparisons, for each respondent selecting more than one option in the range, the centroid of the selected options was calculated (see Methods). The coloured dots are the averages of the selected single ranges (or centroids of multiple ranges) across all respondents within the language-specific survey. The totals (big circles) follow the same rule but are not restricted to language-specific surveys. Thus, they represent the average across all respondents (NOT across surveys) and yield the best estimates of quantity of required data for each type, based on the largest number of responses and irrespective of language.

When respondents were asked to focus at the ecosystem level, and identify the scales at which these primary biodiversity data were needed or useful, no clear pattern emerged. The requirements were fairly well spread over all ranges and ecosystem types. As shown in Figure 30, the range scale includes global (broadest) down to local (narrowest). We highlight the fact that, in some language-specific versions (FR, ES) of our survey, the term "regional" may have been misunderstood (in these languages it means something *below* national level, not above it). Given the high number of Spanish-speakers among the respondents, this effect (that cannot be tested from the dataset alone) may have had a large effect on this distribution of responses.

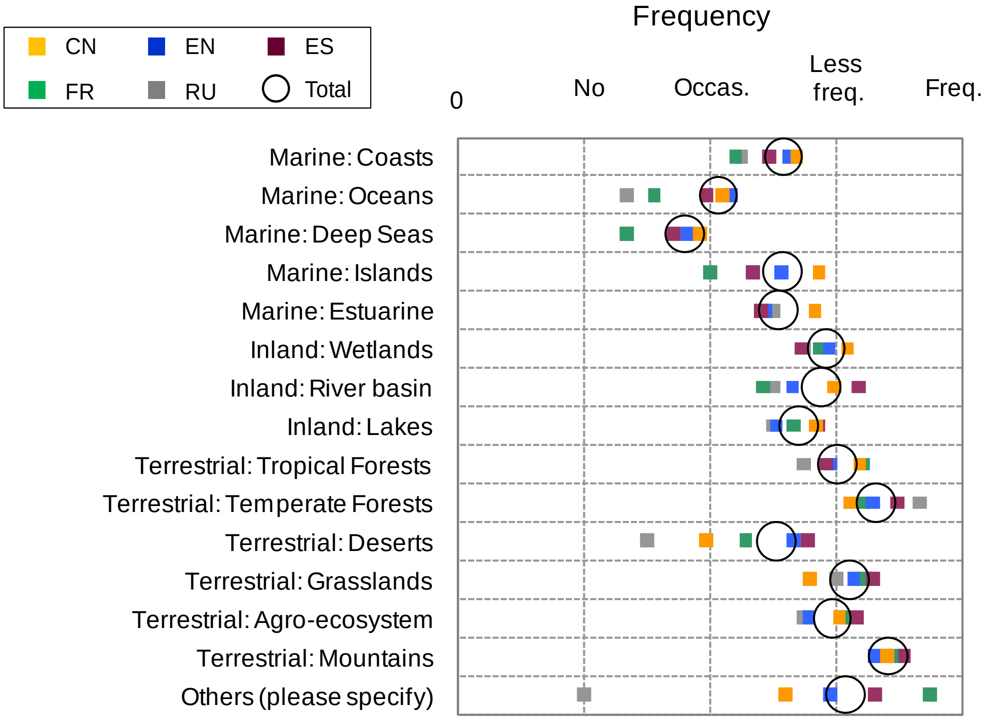


Figure 29: Frequency of use or need for primary biodiversity data according to environment type: Table 1, Q12: "For which type of environments do you use/need more primary biodiversity data?". See Figure 26 for an explanation of the metrics.

Ecosystem level	required scale				
	local	provincial	national	regional	global
Ecoregions	97	98	156	206	132
Protected areas	135	116	196	149	76
Vegetation coverage	144	127	158	163	63
Temperature	160	114	131	145	74
Precipitation	160	110	126	134	57
Soil	155	103	95	103	39
Watersheds	108	98	107	105	33
Basins	97	89	94	95	25
Others	15	9	12	15	10

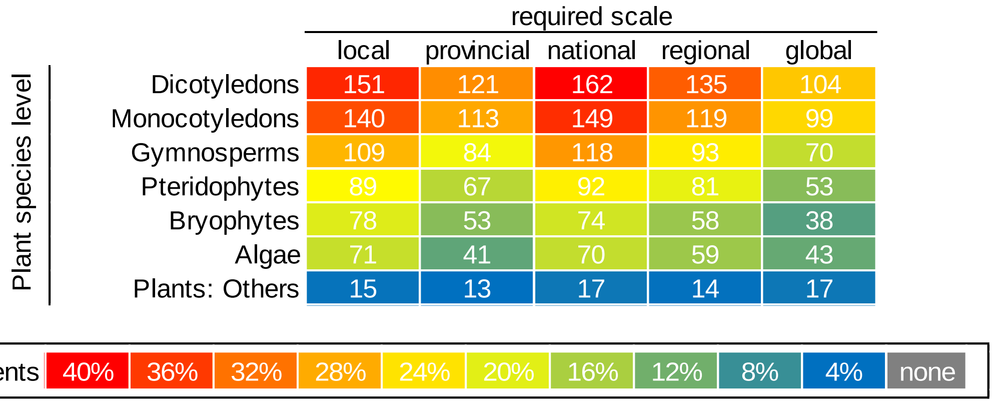
respondents	45%	40%	36%	31%	27%	22%	18%	13%	9%	4%	none

Figure 30: Ecosystem level data requirements. Frequencies of responses to Q13: "Which data at the ecosystem level are the most required by you and at what scale?" (Table 1.)

SPECIES-LEVEL DATA REQUIREMENTS

Plants

The survey revealed that data at all scales (from local to global) were in demand, with no taxonomic pattern across scales (please note the caveat on "regional", above). Taxonomically, higher plants were slightly more in demand, although not significantly so (Fig. 31). This may well reflect either the spread of active taxonomists across groups, or an imbalance in the use of taxa for ecological studies.



Plant species level	local	provincial	national	regional	global
	required scale				
Dicotyledons	151	121	162	135	104
Monocotyledons	140	113	149	119	99
Gymnosperms	109	84	118	93	70
Pteridophytes	89	67	92	81	53
Bryophytes	78	53	74	58	38
Algae	71	41	70	59	43
Plants: Others	15	13	17	14	17

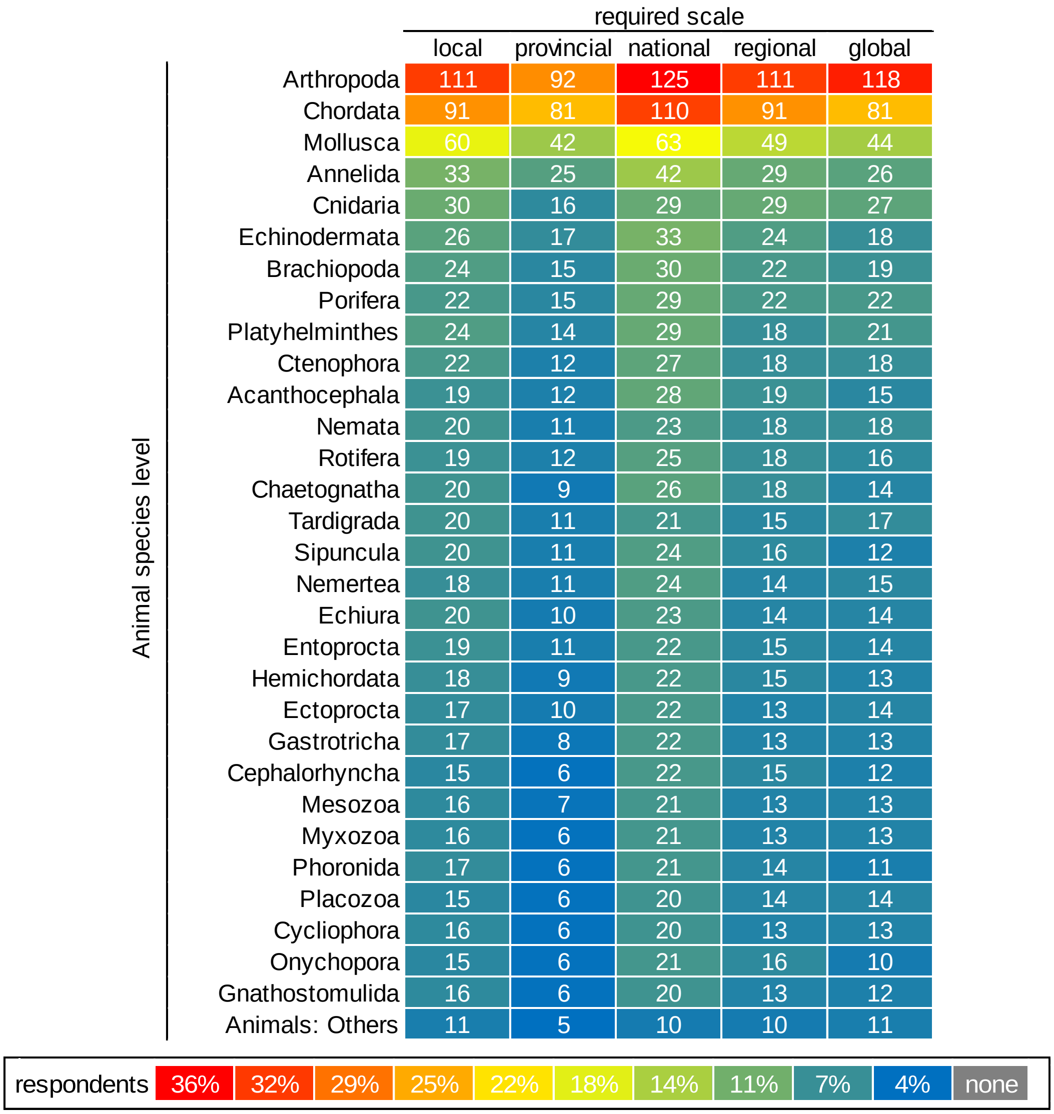
Figure 31: Data requirements at plant species level. Frequencies of responses to Q14: "Which data at the plant species level are most required by you and what scale?" (Table 1.)

Animals

As depicted in Figure 32, three taxon groups heavily dominate the data needs: Arthropods, Vertebrates, and (in a lower tier) Molluscs. The remaining groups are mentioned by respondents much less often. Users seemed to demand data more often for higher animals, as well as species occurrence data related to ecological and public health factors. However, this outcome may reflect existing biases in the actual body of zoological knowledge and the taxonomic coverage: vertebrates have been traditionally well studied (constituting the vast majority of GBIF-mediated available data, with birds and fish dominating), and are the focus of many conservation programs. At the same time, entomological data needs include the largest groups of pests and other species of interest.

Other taxa

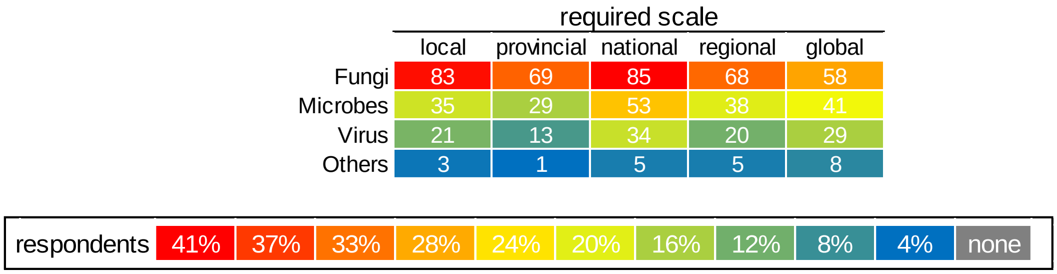
Interest in other organisms was halved among respondents as compared to plants and animals (Fig. 33). Despite the ecological importance of microflora, data on these were only halfway in demand relative to fungi and viruses. Again, this result may reflect the traditional paucity of ecosystem-level studies on these groups, rather than a genuine lack of interest in these extremely important groups. As before, no particular pattern was detected in the geographical width (scale) of the requirements



Animal species level	required scale				
	local	provincial	national	regional	global
Arthropoda	111	92	125	111	118
Chordata	91	81	110	91	81
Mollusca	60	42	63	49	44
Annelida	33	25	42	29	26
Cnidaria	30	16	29	29	27
Echinodermata	26	17	33	24	18
Brachiopoda	24	15	30	22	19
Porifera	22	15	29	22	22
Platyhelminthes	24	14	29	18	21
Ctenophora	22	12	27	18	18
Acanthocephala	19	12	28	19	15
Nemata	20	11	23	18	18
Rotifera	19	12	25	18	16
Chaetognatha	20	9	26	18	14
Tardigrada	20	11	21	15	17
Sipuncula	20	11	24	16	12
Nemertea	18	11	24	14	15
Echiura	20	10	23	14	14
Entoprocta	19	11	22	15	14
Hemichordata	18	9	22	15	13
Ectoprocta	17	10	22	13	14
Gastrotricha	17	8	22	13	13
Cephalorhyncha	15	6	22	15	12
Mesozoa	16	7	21	13	13
Myxozoa	16	6	21	13	13
Phoronida	17	6	21	14	11
Placozoa	15	6	20	14	14
Cycliophora	16	6	20	13	13
Onychopora	15	6	21	16	10
Gnathostomulida	16	6	20	13	12
Animals: Others	11	5	10	10	11

respondents	36%	32%	29%	25%	22%	18%	14%	11%	7%	4%	none

Figure 32: Animal species level data requirements. Frequencies of responses to Q15: "Which data at the Animal species level are the most required by you and at what scale?" (Table 1.)



	required scale				
	local	provincial	national	regional	global
Fungi	83	69	85	68	58
Microbes	35	29	53	38	41
Virus	21	13	34	20	29
Others	3	1	5	5	8

respondents	41%	37%	33%	28%	24%	20%	16%	12%	8%	4%	none

Figure 33: Data requirements at microbes, fungi and virus species level. Frequencies of responses to Q16: "Which data at the Fungi, Virus and Microbial species level are most required by you and at what scale?" (Table 1.)

Types of species-level occurrence data

As expected, precise and accurate geo-referenced data is the most important, desirable, property for most users who are interested in working with species occurrence data. This goal is followed by the desire for species habitat descriptions, taxonomic accuracy, and also ancillary data associated with specimens. Perhaps surprisingly, users also look for images describing species and its habitat. This latter need may be satisfied by referring to appropriate pages (where available) from Encyclopedia of Life (Encyclopedia or Life, 2011).

USEFULNESS OF GBIF MOBILISED DATA

Cases where GBIF provides adequate data

As depicted in Figure 35, more than half (55%) of the respondents suggest that GBIF mobilised data met their needs, either completely or partially. A small minority of the respondents felt that GBIF-mobilised data were not useful for them at all (see below). At the same time, a large cluster of respondents (41%) had never used GBIF-mobilised data. This highlights the obvious, but critical, point that there always is a need to undertake efforts to encourage the use of GBIF mobilised data, especially if the main reason for lack of use is simply lack of awareness of the resource.

We attempted a cross-tabulation of two fundamental factors relating to utility: the perceived usefulness of GBIF mobilised data, and the types of data required by the users. The fact that the majority of respondents make at least partial use of GBIF mobilised data suggests that these data are widely used for basic tasks, including initial exploratory analyses. It is interesting that there was a 50-50 split amongst the respondents who used GBIF-mobilised taxonomic and/or occurrence data, and those who had never used such data. Respondents who indicated that GBIF mobilised data were useful had also expressed a strong need for descriptive information (at the species level).

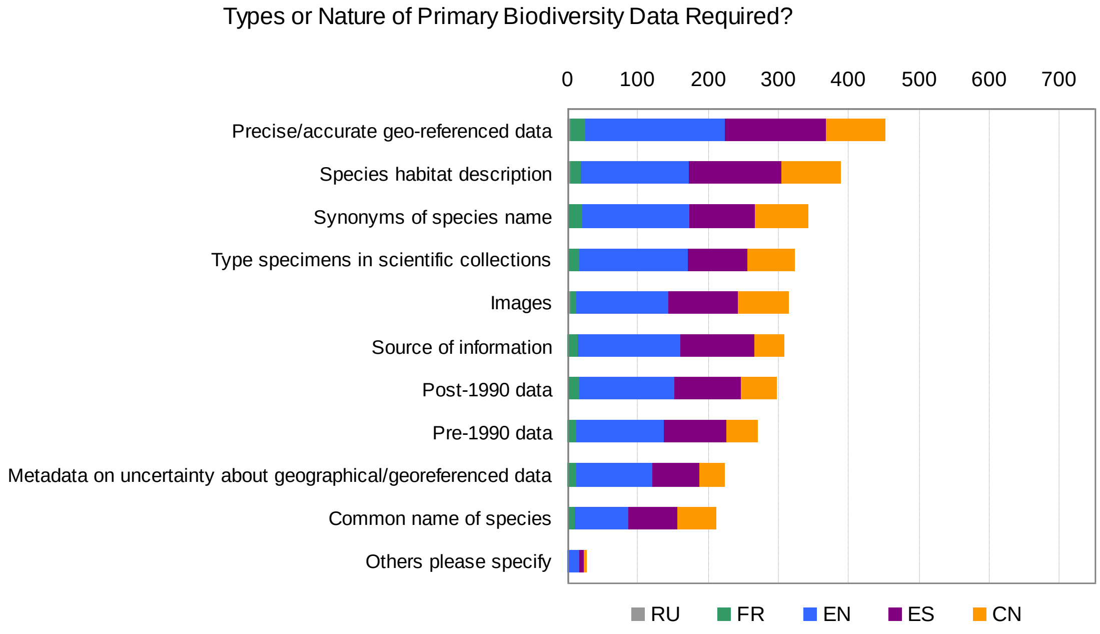


Figure 34: Required characteristics for species occurrence data. Frequencies of responses to Q17: “What are the most important characteristics that you generally want for species occurrence data?” (Table 1.)

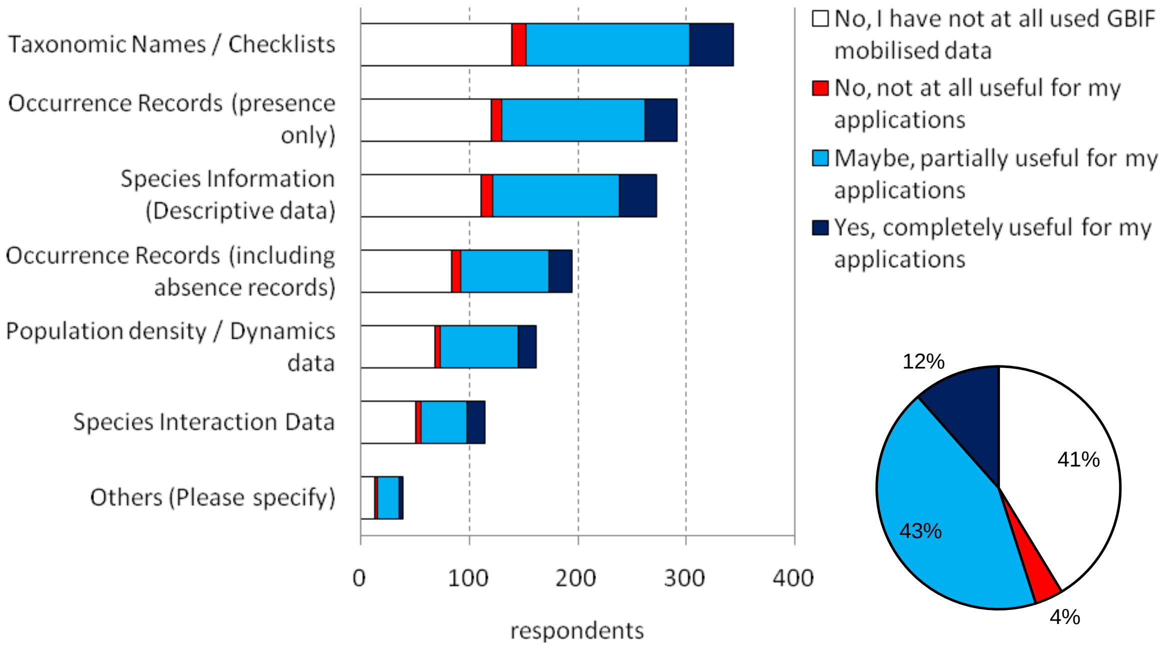


Figure 35: Percentages of people finding GBIF-mobilised data useful. Frequencies of responses to Q18: "Does GBIF mobilised data satisfy your needs?" and breakdown of frequencies according to types or nature of data required (Q10).

Cases where GBIF data do not cover user needs

Figure 36 collates a number of concerns about why GBIF data are not found useful by some respondents. This information here is recoded for analysis into homogeneous groups. It also includes recoded verbatim answers. The term, "More detailed data" collates requests for better coverage, finer detail, finer geo-referencing, gap filling, and the like. The term, "Already satisfied by GBIF" includes various requests mentioning items or data that in fact are actually provided by GBIF. We note that in most cases respondents are not aware of this existing provision. The term, "Excessive data" includes cases where respondents referred to data that was deemed not pertinent/not suitable for them, and expressed a preference to remove these from the databases (see Annex for a full list).

Particular answers for the remaining sub-questions can be roughly categorized according to the kind of perceived data limitations. Three questions focused on the general, quantitative, availability of data (its span across themes), and three focused on the confidence the researchers would put in the data according to perceived quality. Some respondents appreciate a general need for more data or better data, while others qualify this lack according to particular fields of research, taxa, or geographical areas. See Annex for a full list. Answers can be grouped according to these categories as shown in Figure 37, where the shading reflects the number of responses placed in each category. Most respondents who perceived a lack of quality attributed this to the whole dataset. However, in considering the issue of data coverage, respondents focussed on particular areas, probably according to expertise. It may be assumed reasonably that a number of respondents may be attributing to the whole dataset problems that pertain to their particular field of competence or geographical interests.

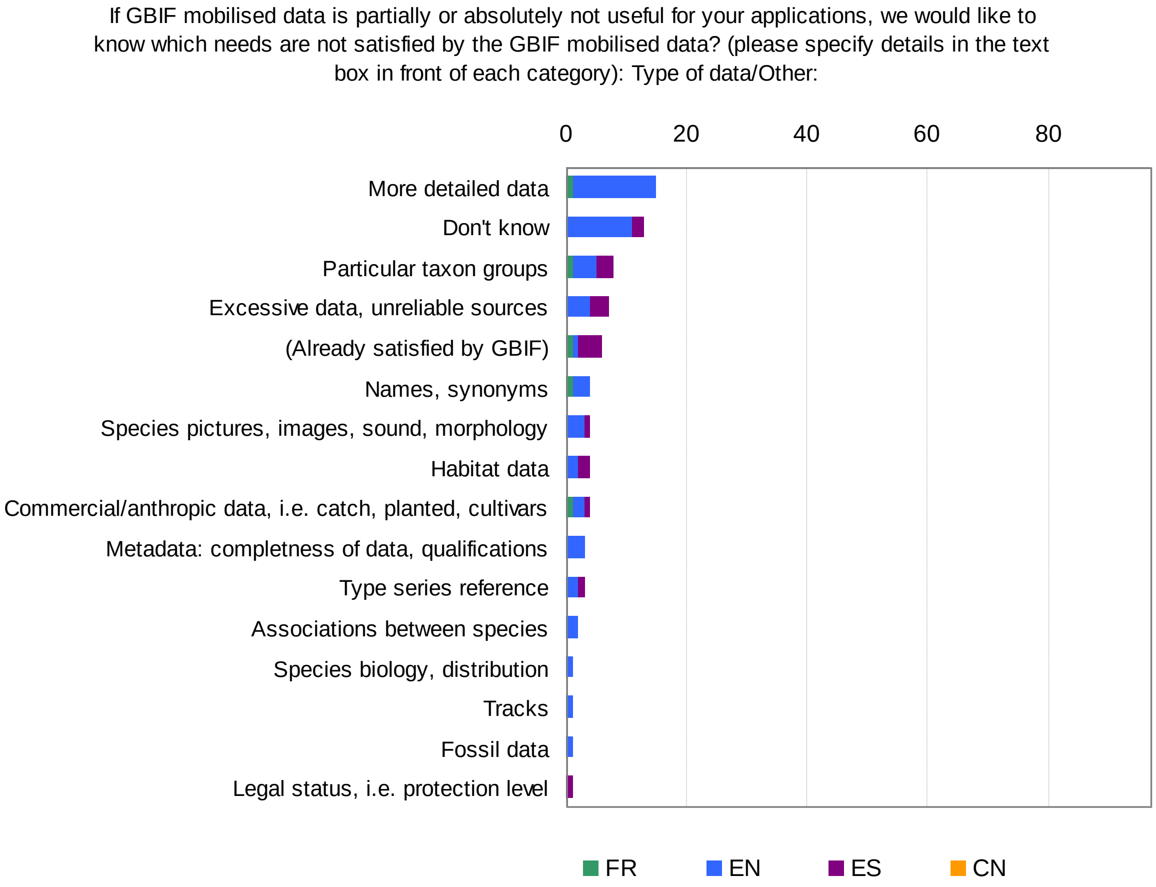


Figure 36: Needs not satisfied by GBIF mobilised data. Frequencies of responses to Q19: “Which needs are not satisfied by the GBIF mobilised data?”. Classes have been recoded from the original options and verbatim answers (see text).

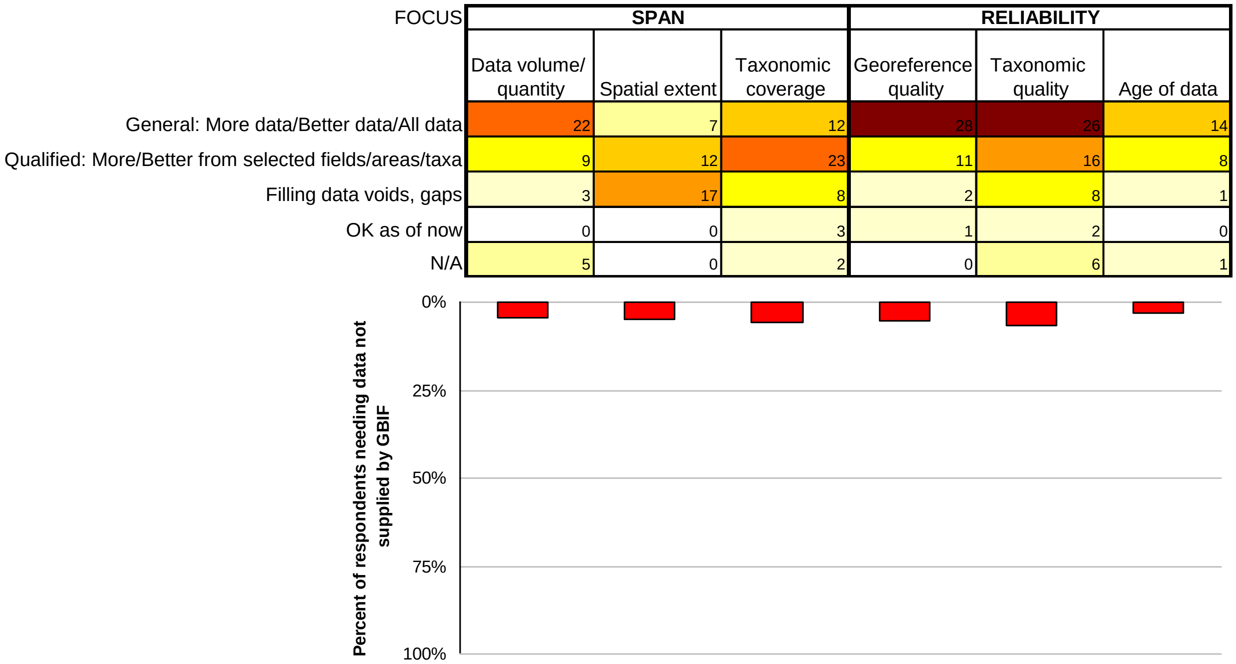
Note, however, that the number of respondents finding issues is relatively low: from 3.1% of all respondents (Age of Data) to 6.7% (Taxonomic quality).

Wish list

The GBIF network is most sought after for the discovery and access it facilitates to species occurrence and names data. Demand for occurrence data, having an established basis through specimens, publications, observations, sequences and multimedia etc., is increasing rapidly. This demand is closely matched by that for the names or checklist data (Fig. 38).

We note that most of 32 respondents who suggested “other” data type in fact were actually suggesting existing types, i.e. images, georeferenced data, etc. Some interesting example suggestions, however, could be identified, such as, for example:

- Ornamental, commercial species data from any provenance (ledger-based occurrence data)
- Images and historical data about type series
- Raw literature data, i.e. direct links to electronic publications
- Quantitatively-oriented data, such as in field ecology
- Species management data.



FOCUS	SPAN			RELIABILITY		
	Data volume/ quantity	Spatial extent	Taxonomic coverage	Georeference quality	Taxonomic quality	Age of data
General: More data/Better data/All data	22	7	12	28	26	14
Qualified: More/Better from selected fields/areas/taxa	9	12	23	11	16	8
Filling data voids, gaps	3	17	8	2	8	1
OK as of now	0	0	3	1	2	0
N/A	5	0	2	0	6	1

Figure 37: Group categories for the perceived quality issues in the datasets.

Some representative examples of needs (interpreted)[5] can be found in Box 1.

Data volume/quantity	Spatial extent	Taxonomic coverage	Georeference quality	Taxonomic quality	Age of data
- Download limit - Not enough results/data - Scant data for selected taxa or regions	- Spatial bias, gaps - Africa, Tropics, Pacific patchy - Local coverture often missing	- Incomplete coverage of groups - Some groups absent/poorly covered: Acari, Geometridae, Basidio-mycota, etc.	- Poor in places (i.e. Africa); imprecise data - Errors in coordinates, i.e. +/- - Metadata lacking: datum	- High concern about identifications: ID of taxonomist lacking - Concern about curation - Synonymies missing; choice of taxonomies	- Data from all ages needed - Historical gaps - Recent revisions missing

Box 1: Representative examples of user data need.

[5] These verbatim answers have been archived, and are available for further analysis on request.

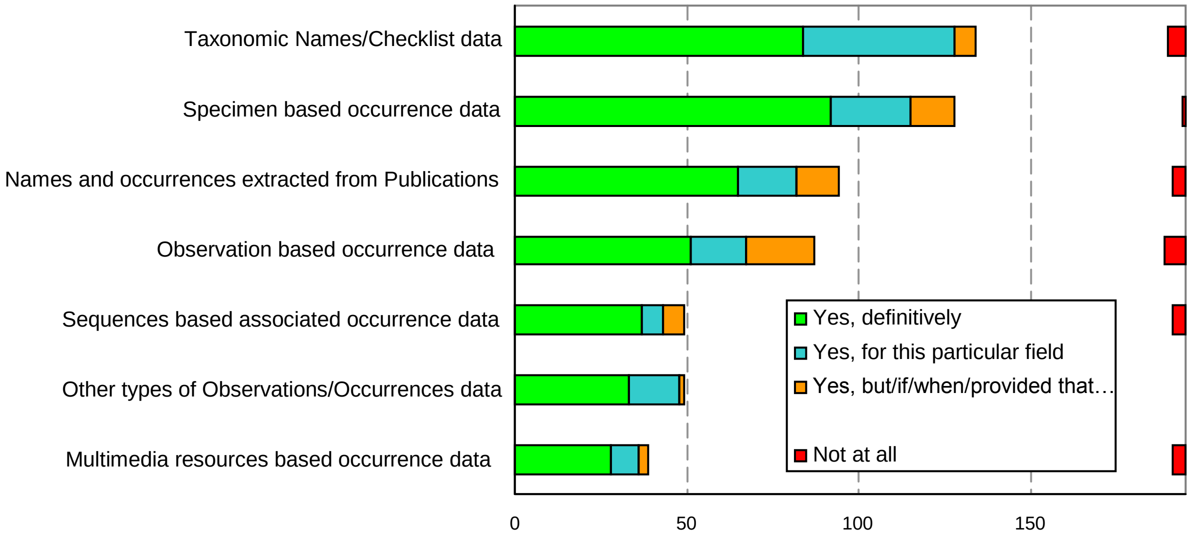


Figure 38: Demand for types of data among respondents, re-categorised from free-text answers (available upon request). Frequencies of responses to Q20: "What type of data would you like to see becoming increasingly discoverable and accessible through GBIF?"

Another big issue is the call for DNA sequence data and other genetic diversity data (particularly anticipating large scale, next generation sequencing studies.) Linkages between DNA barcoding of collected specimens, identified to species and geo-referenced, and GBIF geo-referenced data for the same species, will perhaps be one of the most efficient development for many potential users.

CONCLUSIONS

The CNA survey exercise has provided a good picture of what users know about the availability of GBIF-mediated data, what information they would like to have and use, and what they perceive as lacking (or requiring improvements in availability). Importantly, this survey also reveals the wide breadth and scope of interests among the community of potential and actual users. We conclude that GBIF could build on its current services, and at the same time steer future developments in order to cater for the full spectrum of users. This goal may be achieved, most likely, by enhancing the GBIF linkages to other data types and sources, such as molecular and environmental data.

While providing much insight on the expectations of users, the CNA exercise also uncovered survey properties that may raise concerns about whether all these aspects of user-needs have been accurately conveyed. A comparison of CNA survey with a similar survey conducted in English only highlights dangers in not fully taking into account the diversity of users' circumstances. This can reduce the degree to which the full spectrum of user-needs are expressed through the survey. In particular, our study clearly shows that the level of responses elicited from target users is strongly tied to the ability to address the user in his/her own language. Future surveys should certainly be designed to cover most of the target user population in either their first of second language in order to ensure a wider coverage. The chosen languages in this study (UN official languages) might be adequate in this respect.

A challenge for future CNA work, in setting out to capture the full spectrum of data needs for biodiversity research, will be to ensure reaching that maximum breadth of researchers, in a representative, homogeneous, manner. New data/information challenges are emerging through national and international programs and activities, including those related to the new post-2010 targets of the Convention on Biological Diversity, the global Biodiversity Observation Network (GEO BON) (Andrefouet et al., 2008), and the new intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES, 2011). These challenges particularly involve needs to integrate biodiversity with ecosystem services and other needs of society, for research, observations, assessments, and policy development. We touch on some of these issues in the companion paper on CNA recommendations (Faith et al., this volume).

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